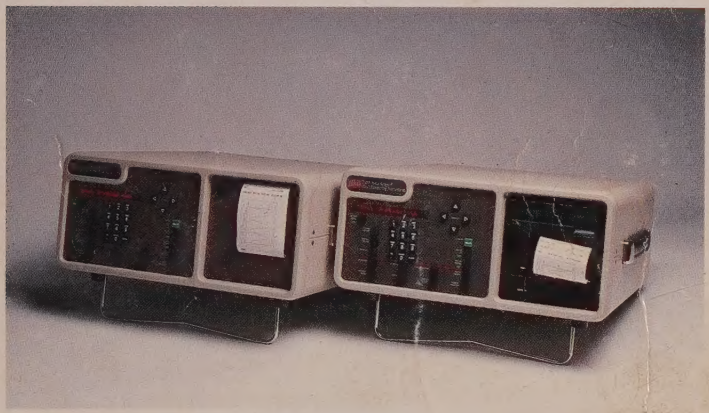
GE Rental/Lease
Rental Accessory
Failure to return this item will result in a minimum charge of $100.00
1-800-GE-RENTS
GE-11

PowerScope User's Guide



2400 and ~~2460~~ PowerScopes

BMI
Basic Measuring Instruments
335 Lakeside Drive
Foster City, CA 94404

$50

Copyright
© 1989 Basic Measuring Instruments. All rights reserved.
PowerScope® is a registered trademark of Basic Measuring Instruments.

Written by Mary Lautner, Vince Migliore and Ann Scheuerell.

Operators Safety Summary

Warning : This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the User's Guide, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against each interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

The servicing instructions in this manual are for use by qualified personnel only. To reduce the risk of electrical shock, do not preform any servicing other than that contained in the operating instructions unless you are qualified to do so.

Incoming ground: The power plug is grounded. For continued protection against risk of electrical shock and fire, do not defeat the grounded plug.

Ventilation: This unit is fan cooled. For continued protection against risk of electrical shock and possible fire hazard, do not allow the fan opening to become blocked.

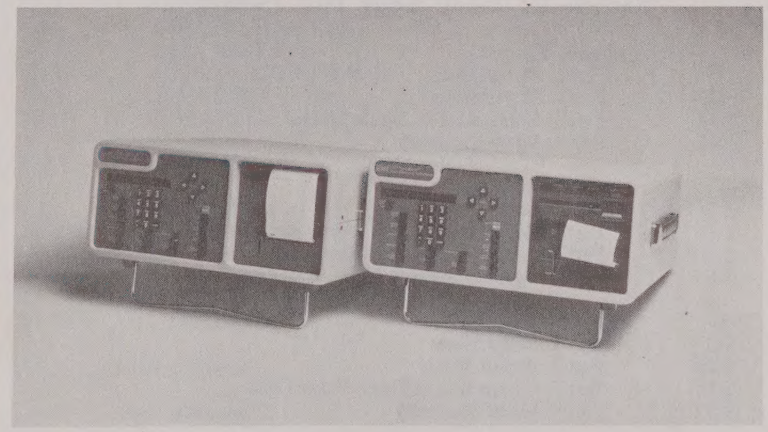
Symbols as marked on equipment:

This symbol indicates maximum input voltage to instrument not to exceed 600 Vrms.

Protective ground (earth) terminal.

UL File Number E95890
Hewlett Packard Divisional Purchase Agreement #125
Digital Equipment Company Part Number FC-10118 AC
General Services Administration Contract Number GS00F93673

WARNING
The installation instructions in this manual are for use by qualified personnel only.
Do not install this instrument on a power line unless you are qualified to do so.
High voltages that cause burns and lethal shocks are present during power monitoring. When making connections to power lines, always connect the safety earth ground first. USE STANDARD HIGH-VOLTAGE, HIGH-CURRENT SAFETY PRECAUTIONS.



BMI models 2400 and 2460 PowerScopes

Power line disturbances disrupt and damage today's sophisticated electronic equipment.

The PowerScope is a portable instrument that captures and graphs power line disturbances. When used with a new reference book, the Handbook of Power Signatures *(page 6-8), you can find the cause of your power quality problem easily, and solve it efficiently.*

i **Section I: Welcome to Your PowerScope**

ii **Contents**

iv **Impatient User's Guide**
- iv Part 1: Trying it Out
- x Part 2: Operating Sequence
- xii Part 3: Menus and Keyboard

xvi **The Electronic Operating Envelope**
- xviii Helpful Hints About Operation

1-1 **Section II: Using Your PowerScope**

1-1 **Single Phase**
- 1-2 Part 1: Setup Menu
- 1-22 Part 2: Report Menu
- 1-44 Part 3: Connecting to Single Phase
- 1-46 Part 4: Menu Summary

2-1 **Dual-OnePhase**
- 2-2 Part 1: Setup Menu
- 2-32 Part 2: Report Menu
- 2-60 Part 3: Connecting to Dual-One Phase
- 2-64 Part 4: Menu Summary

3-1 **Three-Phase Delta**
- 3-2 Part 1: Setup Menu
- 3-22 Part 2: Report Menu
- 3-50 Part 3: Connecting to Three-Phase Delta
- 3-52 Part 4: Menu Summary

4-1 **Three-Phase Wye**
- 4-2 Part 1: Setup Menu
- 4-32 Part 2: Report Menu
- 4-60 Part 3: Connecting to Three-Phase Wye
- 4-62 Part 4: Menu Summary

5-1 **DC or Custom Setups**
- 5-2 Part 1: Setup Menu
- 5-52 Part 2: Report Menu
- 5-82 Part 3: Connecting to Special Setups
- 5-86 Part 4: Menu Summary

6-1 **Using Probes**
- 6-2 Probes
- 6-8 Accessories

7-1 **If You Have a BMI 2460**
- 7-2 Description
- 7-4 Storage Menu

8-1 Key Operator Menu

9-1 Communication Menu
9-2 Setup Menu
9-10 Modem
9-14 Type
9-22 Configuration
9-26 Port

10-1 Operation
10-2 MONITOR Key
10-4 STATUS Key
10-4 LOCK Key
10-6 CALIBRATION Key
10-6 SELF TEST Key
10-8 CANCEL PRINTER Key
10-8 STORE SETUP Key
10-10 RECALL SETUP Key

11-1 Loading Paper

12-1 Troubleshooting
12-3 Troubleshooting Chart

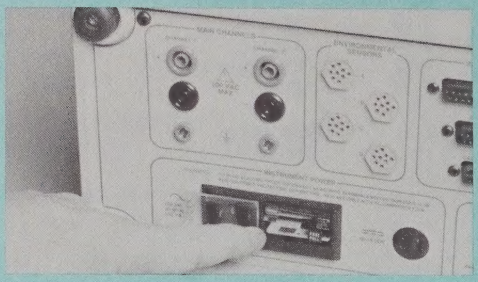
13-1 Specifications and Technical Description
13-2 General Technical Description
13-12 Specifications

A-1 Appendices

A-1 A. Graphs
B-1 B. Recommended Thresholds

Your Comments Please

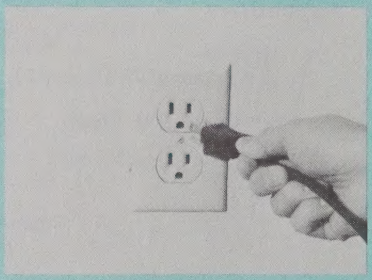
1. Check the supply voltage on the back panel of the PowerScope.



The supply voltage is set with a small PC card positioned under the fuse holder on the back of the instrument. Check that the PC card is positioned so that you can read your supply voltage when the card is inserted into the PowerScope. If the setting doesn't match your supply voltage, use a needle-nose pliers to gently pull the PC card out and reinsert it so that the supply voltage is visible.

Supply Voltage Setting	Working Range
120 VAC	90-150 Vrms
240 VAC	190-260 Vrms

2. Plug your PowerScope in.

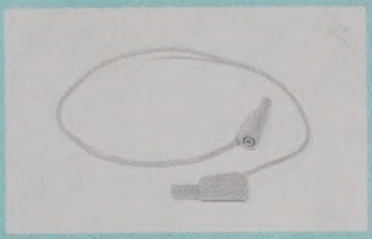


Find the power cord in the shipping container and plug your PowerScope into a wall outlet. As soon as you do this, the display will light up with "Idle" or "Monitor".

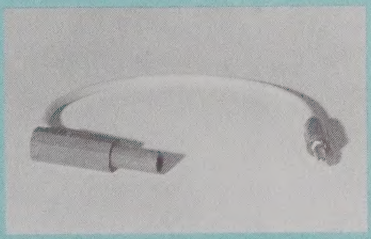
3. Connect your PowerScope for monitoring single-phase power.

Find these monitoring cables in the shipping container:

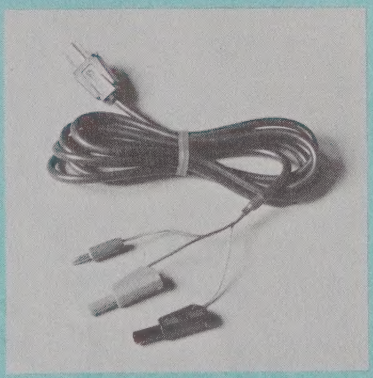
One blue jumper cable



One yellow ground cable with green ground plug



One measuring cable with black, red, and green connections on one end, and a wall plug on the other.



A. Using the measuring cable, plug the green connector into the Channel 1 green (ground) socket, and plug the red connector into Channel 1 red (positive) socket.

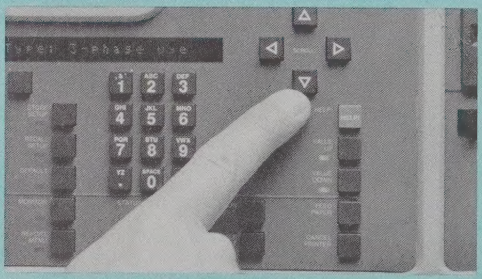
B. Plug the black connector of the measuring cable first into a blue jumper cable, then into the Channel 1 black (negative) socket. Plug the other end of the blue jumper into the Channel 2 red (positive) socket.

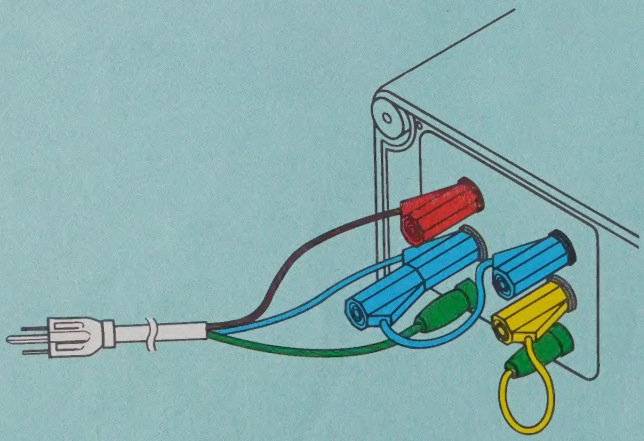
C. Plug one end of the yellow ground cable into the Channel 2 green (ground) socket, and the other end into Channel 2 black (positive) socket.

D. Last, plug the three-prong plug of the measuring cable into a wall socket.

WARNING

You are working with high voltages that cause burns and lethal shocks. Connect the safety earth ground first. USE STANDARD SAFETY PRECAUTIONS.





4. Press the RECALL SETUP key.

NOTE: If "Summary rpts: PRINT" appears in the display it's because the PowerScope has strip charts to print from a previous monitoring session.

Use the VALUE UP/VALUE DOWN keys to position CLEAR in the display, then press the down arrow.

Then press the RECALL SETUP key again and proceed.

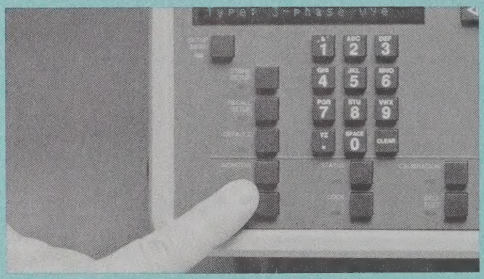
5. Use the VALUE UP/VALUE DOWN keys to position DEFAULT in the display.

DEFAULT restores reasonable threshold settings for monitoring 120 V, 60 Hz single-phase power.

6. Press the down arrow.

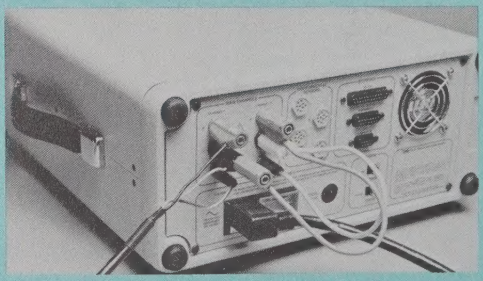
7. Press the MONITOR key.

Immediately a Threshold Report will be printed showing the current settings, then an Initial Waveshape Report will be printed showing the electrical sine waves.



8. Now, unplug the measuring cable to create a disturbance.

Your PowerScope will automatically report the disturbance with waveshape faults, sags, and/or surges, and impulses if they occurred. Monitoring with the PowerScope is that easy!



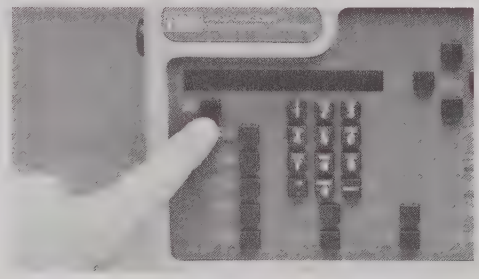
If you have any questions at all, please call a BMI Customer Service Engineer. We'll be glad to help you:

Inside California: (800) 451-3040
Outside California: (800) 634-1233

Part 2 Operating Sequence

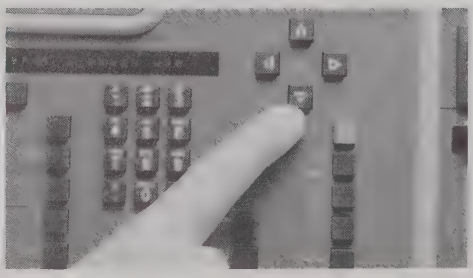
Part 2 of the Impatient User's Guide explains the usual sequence for operating the PowerScope.

1. Press the SETUP MENU key.

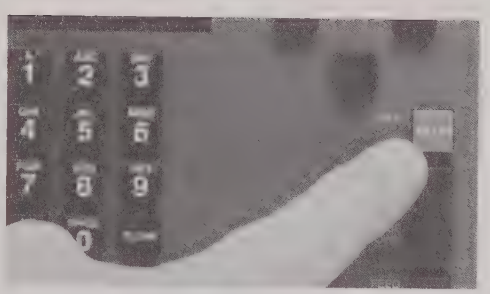


2. Use the VALUE UP/VALUE DOWN keys to scroll through the choices for each question in the menu.

3. Press the down arrow to go to the next question.



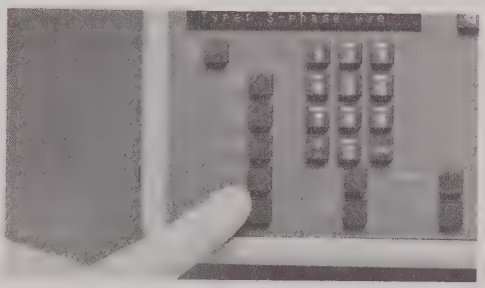
4. Press the HELP! key at any time for a printed explanation of what the question means or what to do next.



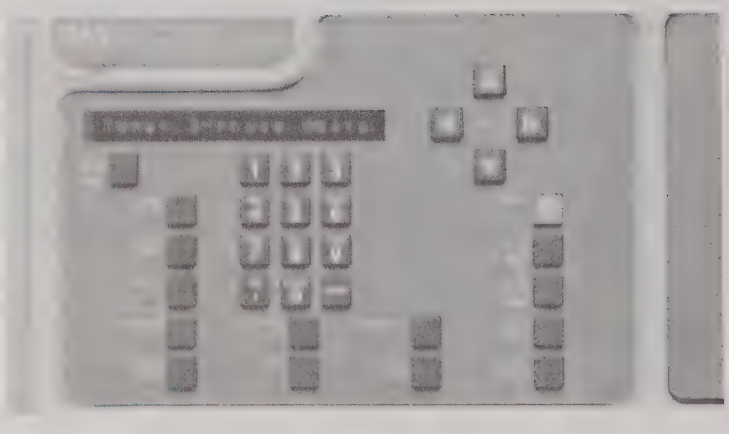
5. Connect the PowerScope to the power line. When you get to the question called "TYPE:" in the Setup Menu, press the HELP! key for a quick explanation on how to connect the PowerScope, or see the following pages:

Connecting to single-phase - page 1-44.
Connecting to dual-one phase - page 2-60
Connecting to three-phase delta - page 3-50
Connecting to three-phase wye - page 4-60

6. Press the MONITOR key. Disturbance graphs will be printed automatically.



7. Press the CANCEL PRINTER key, then the up arrow to reset the PowerScope.



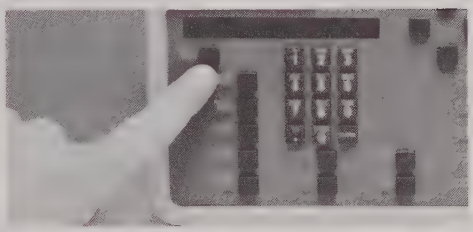
SETUP MENU	Accesses Setup Menu (Setup Menu then up arrow = Key Operator Menu)
STORE SETUP	Writes on-line memory into storage.
RECALL SETUP	Reads stored settings into on-line memory.
DEFAULT	Enters reasonable limits for some thresholds.
MONITOR	Prints current threshold settings and starts monitoring the power line.
REPORT MENU	Accesses Report Menu, which turns specific graphs and reports on or off. (Monitor then up arrow = immediate monitoring)
STATUS	Samples power line and provides a text report for the voltage, high-frequency noise at monitor's input terminals, and internal battery condition.
LOCK	Locks keyboard.
CALIBRATION	Calibrates instrument, using external A-016 Precision Calibrator.
SELF TEST	Provides printout of current software version installed, initiates instrument self-diagnosis, and prints report.
SCROLL arrows	Moves cursor in display, scrolls through questions in menus.
HELP!	Provides printout on how to proceed.
VALUE UP/VALUE DOWN	Scrolls up and down through possible choices for one parameter.
FEED PAPER	Causes paper to advance.
CANCEL PRINTER	Cancels printer action instantaneously. (Cancel printer then up arrow = reset)
Numerical/Letter keypad	Used for making control settings.
CLEAR	Clears an entry.

HELP!

Five menus control the data you receive from the PowerScope:

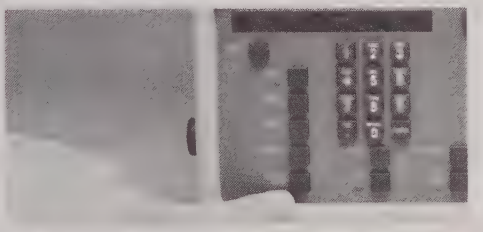
1. Use the Setup Menu to adjust the limits that define a power disturbance.

(Press the SETUP MENU key.)



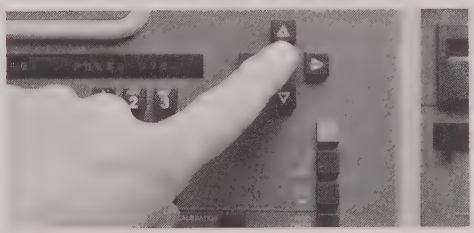
2. Use the Report Menu to specify the disturbance graphs, strip charts, and summary reports you want printed.

(Press the REPORT MENU key.)



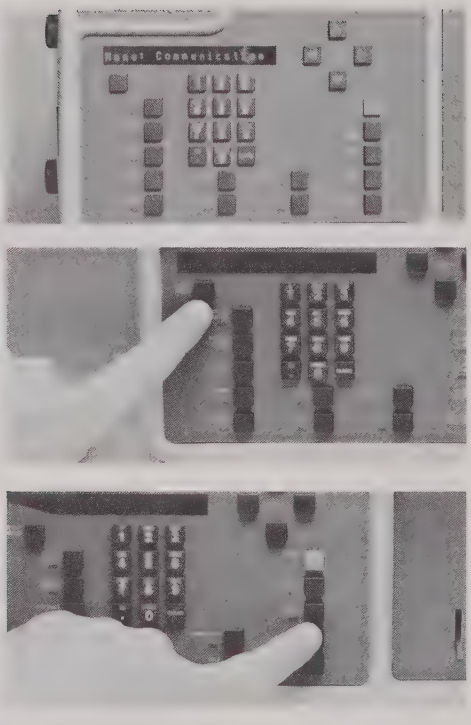
3. Use the Key Operator Menu to control administrative detail such as the setting of the clock and calendar, whether temperature should be reported in Centigrade or Fahrenheit, etc.

(Press the SETUP MENU key, then the up arrow.)



4. Use the Communication Menu to control the flow of data over the phone line via internal or external modem, or via the RS-232 interface.

(Press the SETUP MENU key, the up arrow, then press the VALUE DOWN key.)



5. Use the Storage Menu when your 2400 PowerScope has an A-600 Parallel Processor connected, or to control disk storage on your 2460 PowerScope.

Press the same keys as in step 4. Press the VALUE DOWN key a second time to reach the storage menu.

Electronic Operating Envelope

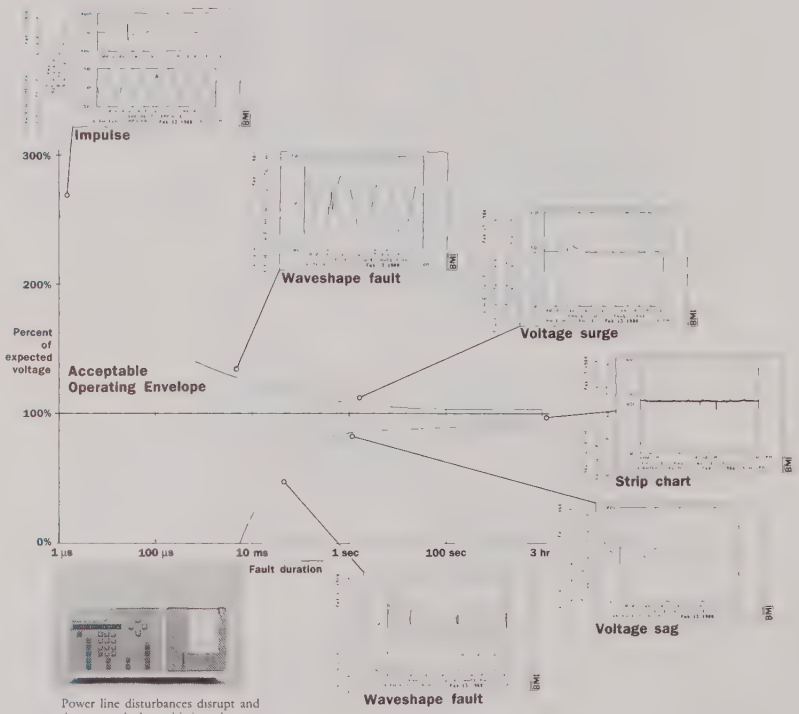
Electronic equipment will function successfully when the available power falls within this operating envelope. As illustrated by the graph (opposite), the amplitude and duration of disturbances are the characteristics that determine if power falls outside of the envelope.

To formulate a complete diagnosis of power quality, a power monitor must detect all disruptive disturbances for voltage and current. These include impulses, wave-shape faults, sags and surges, and in addition, total harmonic distortion, frequency spectrum, frequency variations, high-frequency noise, radio-frequency interference, temperature and humidity fluctuations should be considered as possible causes of operating problems.

The PowerScope graphs these disturbances so they can be analyzed, traced to their source, and solved.

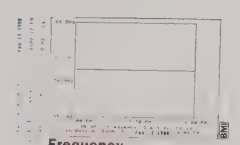
Electronic Operating Envelope

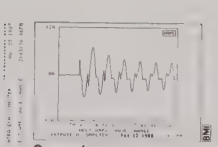
Electronic equipment will function successfully when the available power falls within an acceptable operating envelope.

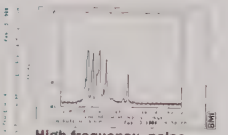


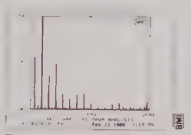
Power line disturbances disrupt and damage today's sophisticated electronic equipment. BMI's PowerScope™ detects power line disturbances, analyzes them, identifies their cause, and helps select a solution.

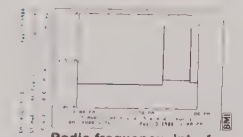
HELP!


Frequency

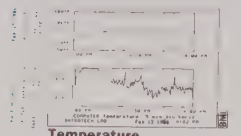

Current


High-frequency noise


Frequency spectrum


Radio-frequency interference

Harmonic analysis


Temperature

Humidity

Basic Measuring Instruments
335 Lakeside Drive
Foster City, CA 94404
Telephone 415 570-5355
TWX 910 374-3059
FAX 415 574-2176

Helpful Hints

Helpful Hints About Operation

For the beginner

• Use the HELP! button when you get stuck.

• To get started, press the SETUP MENU key. Use the up arrow and down arrow keys to work through the menu.

• When you reach the third question in the Setup Menu, "Type:" (power type), press the HELP! key for a quick explanation of how to connect the PowerScope for monitoring the type of power you choose.

• To set the clock and the calendar, use the Key Operator Menu. To get the Key Operator Menu, press the SETUP MENU key, then immediately press the up arrow key.

• To unlock the keyboard, press the LOCK key, then the CLEAR key.

For the advanced user

• Pressing the MONITOR key then immediately pressing the up arrow key starts the PowerScope monitoring without printing threshold reports and initial waveshapes.

• If you're trying to choose reasonable thresholds to characterize an unknown site, try this: 1) Set fairly tight thresholds; then, using the Report Menu, set the strip chart interval to 24 hours, turn off all the disturbance graphs, but leave all the strip charts on. 2) Monitor for 24 to 48 hours. 3) Use the resulting strip charts to select reasonable thresholds for the site, then turn the disturbance graphs back on.

Checking out a new computer site

• If possible, monitor the site before installing the computer. This will allow you to distinguish between presite problems and problems generated after the computer was installed.

• Monitor power at the junction box or circuit breaker panel closest to where the computer will be installed. Monitor temperature and humidity with an A-003 probe placed on the floor where the computer will stand (most computer systems draw air from their base).

• Leave the PowerScope installed for at least one complete business cycle (typically a week).

• Set the PowerScope thresholds to match the requirements of the computer you're going to install. If there isn't any data available on its requirements, start with the thresholds in Appendix B (page B-2).

• Press the STATUS key as soon as you've installed your PowerScope. You will find out if you've installed it correctly, and you may find gross problems immediately (high neutral-to-ground voltages, wiring errors, etc.).

• In this application, you'll usually use the Report Menu to turn off all the disturbance graphs, and just use the strip charts to decide if the site meets your requirements.

• After you complete your site survey, file the strip charts away. They may be extremely valuable in the future to help identify what's changed after the computer has been installed.

• To ensure the new computer system isn't disrupting the power and the environment, it's good practice to continue monitoring for one business cycle after the computer is installed.

Tracking down an intermittent computer problem

• Eliminate, if possible, the most likely causes of intermittent failures: operator errors, software bugs, and loose cables and connections.

• Connect your PowerScope as close as possible to the power source for the equipment that's failing.

• Set your thresholds somewhat tighter than the acceptable power specifications of the equipment. If you lack data on the acceptable power specifications, consult Appendix B (page B-2).

• You may want to use the Report Menu to turn off the disturbance graphs, set the strip chart interval to 1 hour, and monitor for a couple of hours. This will tell you if the power is reasonable, or if it is clearly out of spec.

• If the power looks reasonable, use the Report Menu to turn the disturbance graphs back on, and reset the strip chart interval to 24 hours. Monitor for one business cycle (typically 7 days), and check to see if there is a correlation between the equipment's failure log and the recorded power disturbances.

Checking the effectiveness of a power conditioner

• If you intend to monitor a single-phase power conditioner, you will need to use two BMI model number A-111 AC/DC/Impulse Probes. Use the A-111's on the input of the power conditioner, and the main channels of the PowerScope on the output. Insturctions begin with chapter 2 (page 2-2) and connections are describe on page 2-62. For three-phase power conditioners we recommend you use a model 4800 PowerScope.

• You'll probably want to set the thresholds for the output of your power conditioner somewhat tighter than the thresholds for the input. Otherwise, you'll see disturbances on the input, but won't get a recording of the attenuated disturbance on the output.

• Note that the safety ground connectors are bussed together inside the PowerScope and are also connected to the safety ground of the PowerScope's power cord.

• For long term monitoring of power conditioning effectiveness, use the Report Menu to turn off all the disturbance graphs and set the strip chart interval to 24 hours.

Sizing power conditioners

• If you have current transformers (CT's) already installed on your power lines, you can use them, with appropriate shunt resistors, to graphically record the current requirements of your computer system. Set your PowerScope to the Independent Channels power type (see chapter 5), and use the channels to record the output of your current transformers. Remember to multiply the PowerScope graphs (which will be in volts) by the appropriate correction factor for your shunt resistor and CT to obtain amps.

• The PowerScope's input impedance is approximately 4 megohms. Use an appropriate shunt resistor to obtain full-scale current reading from your CT's of approximately 10 volts.

• To choose the optimum size of power conditioner, be sure to measure the starting current surge of the entire system (electronics, fans, printer motors, disk drive motors, etc.), and measure the operating current as well.

Preventive monitoring

• Preventive monitoring means installing a PowerScope at a site that isn't experiencing any power problems, and leaving it installed. This is typically done at large computer installations, critical control panels, telecommunication control rooms, and other critical load sites.

• Preventive monitoring can show a power environment that is drifting towards a problem threshold (for example, line voltage may decrease over the course of several months as more and more loads are added to a distribution line). It can also be used to detect non-disruptive power disturbances that may decrease equipment life (for example, low-level voltage impulses).

• Typically, for a preventive montioring installation, you will choose thresholds considerably tighter than the acceptable power specifications of the most sensitive equipment at the site. Then use the Report Menu to set the strip chart interval to 24 hours and turn off all disturbance graphs (but leave the strip charts on).

• Review and file the strip charts once each business cycle (typically one per week). If the power is deteriorating, use the Report Menu to turn the disturbance graphs on and analyze the source of the problem. Once the problem is solved, use the Report Menu to turn the disturbance graphs off again.

Monitoring high-voltage power lines (more than 480 volts)

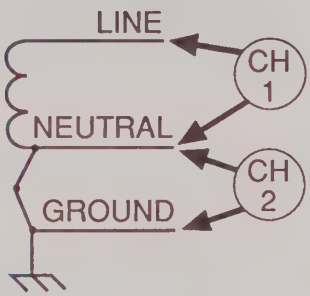
• Use standard Potential Transformers to reduce high-voltage lines to 120 Volts or 240 Volts nominal. The PowerScope's input impedance is greater than 4 megohms, so it can be used with virtually all single-phase and three-phase PT's.

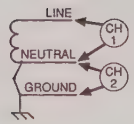
• Remember to adjust your threshold settings by the PT's ratio. For example, on a 12 KV nominal line, a 100:1 PT ratio would give you 120 Volts nominal. If you set your PowerScope surge voltage threshold to 125 Vrms, the actual surge threshold is 12.5 KV.

• Potential Transformers may exhibit some attenuation of high-frequency disturbances (impulses and high-frequency noise.)

Chapter 1

Single-phase





1: Single-phase

This chapter shows you how to set up the PowerScope for monitoring single-phase power.

Quick Guide

1. Press the SETUP MENU key.

2. Answer the questions in the menu using the VALUE UP/ VALUE DOWN keys or the number keypad.

3. Press the down arrow key to go on to the next question.

4. Press the HELP! key if you want further explanation about the question.

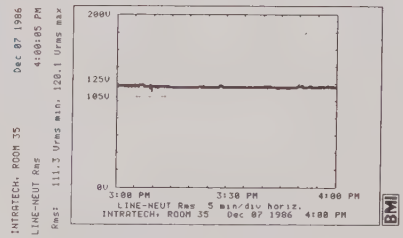
Press the SETUP MENU key now.

If you get the following message in the display, it's because the PowerScope has strip charts from the previous monitoring period.

Summary rpts: Print

Possible selections: Print
Clear

Use the VALUE UP/ VALUE DOWN keys to choose whether you want the pending strip charts.



This is a 1-Hour summary strip chart.

If you want them printed then erased, position PRINT in the display, then press the down arrow. If you want them erased immediately, position CLEAR in the display, then press the down arrow.

Press the SETUP MENU key and proceed.

HELP!

==========

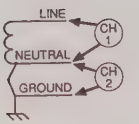
Use the VALUE UP/VALUE DOWN keys to select PRINT or CLEAR and then use the DOWN ARROW key to enter the menu you have selected.

If you select PRINT, the summary data and strip charts that have been gathered so far by the PowerScope will be printed and then reset. If you select CLEAR, all of the summary data and strip charts will be reset without printing.

If you don't want to lose any summary data, you may return to the Monitor mode by pressing the MONITOR key.

(There is no more HELP!)

==========



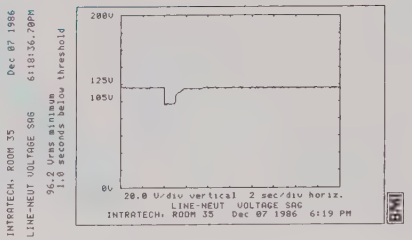
1: Single-phase

Setup Menu, continued

Site: INTRATECH, ROOM

Use the number keys to enter the name of the site where you are monitoring.

Use the left and right arrow keys to move the flashing cursor.



Use the number keys to enter both letters and numbers; for example, to enter the letter "K", press the 5JKL key 3 times. On the first press, a 5 will appear, on the second a J, and on the third, a K will appear.

Now move the flashing cursor to the next position by pressing the right arrow key. Press the 0 SPACE key twice to enter a space. Press the down arrow key to go on to the next question.

HELP!

==========

You may enter up to 20 characters from the keyboard to identify the site that you are monitoring.

Use the left and right arrow keys to move the flashing cursor.

Use the number keys to enter both letters and numbers. For example, to enter the letter 'B', push the '2ABC' key three times.

(Press HELP! again for general information on the Setup Menu.)

==========

==========

The Setup Menu contains questions that define the operating parameters of your PowerScope. Specifically, it asks you to name the monitoring site, state what type of power each channel will monitor, and specify thresholds for each measurement.

The questions in the Setup Menu change automatically depending on what type of power you assign each channel and if you have probes plugged into the environmental channels.

(Press HELP! again for general information on the operating sequence.)

==========

==========

The usual sequence for operating the PowerScope monitor is:

1) Press the SETUP MENU key and answer the questions. To go on to the next question, press the Down Arrow.

2) Connect the monitor to the power line. (See the HELP! message in the Setup Menu for the 'TYPE:' question.)

3) Press the MONITOR key to monitor the power line. Your reports will be printed automatically.

(Press HELP! again for general information on the six modes of operation.)

==========

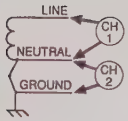
==========

The PowerScope monitor can be in one of six modes:

1) Press the SETUP MENU key to program the Setup Menu. Use the up arrow and the down arrow key to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu. (You may want to press 'HELP!' when you have selected the type of power line you are going to monitor. This will give you installation instructions.)

   By pressing the SETUP MENU key, then immediately pressing the UP ARROW key, you will enter the Key Operator Menu. This menu will give you control of the detailed operation of the PowerScope.

Continued on page 1-7.

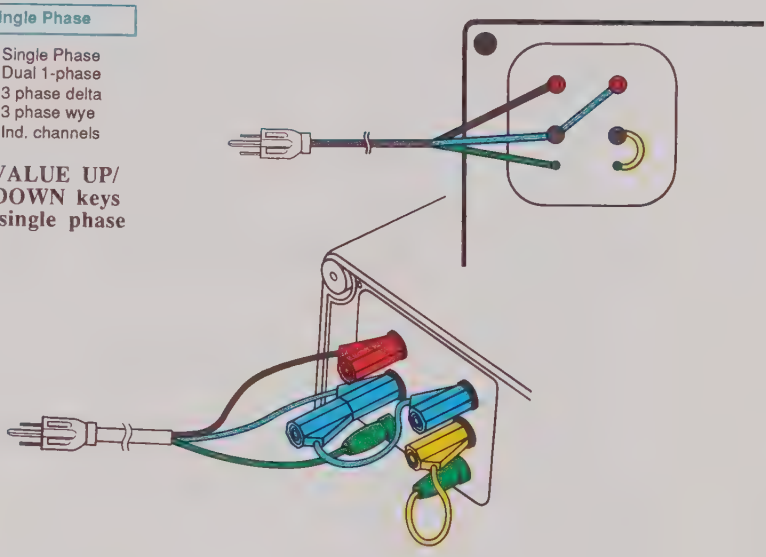


1. Single-phase

Type: Single Phase

Selections: Single Phase
Dual 1-phase
3 phase delta
3 phase wye
Ind. channels

Use the VALUE UP/ VALUE DOWN keys to select single phase power.



Press the HELP! key for information on connecting your PowerScope to single-phase power, or see Part 3 of this chapter on page 1-44.

WARNING
You are working with high voltages that cause burns and lethal shocks. Connect the safety earth ground first. USE STANDARD SAFETY PRECAUTIONS.

HELP!

Continued from page 1-5

```
====================================

Select '1 phase' to monitor a single
phase source.

To install the PowerScope on a single
phase line, make the following
connections:

Channel 1 GREEN terminal: SAFETY
                          GROUND

Channel 1 Red terminal:   Phase
Channel 1 Black terminal: Neutral

Channel 2 Red terminal:   Neutral
Channel 2 Black terminal: Ground

(Press HELP! again for general
information on the Setup Menu.)

====================================
```

2) Press the STATUS key to print the Status Report. This report tells you the present voltage, frequency, and noise on each of the channels. This report can be especially useful when you're trying to set the thresholds correctly. It's also useful for checking to see if you've installed the monitor correctly.

3) Press the REPORT MENU key to enter the Report menu. Use the up arrow and the down arrow to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu.

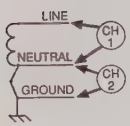
4) Press the MONITOR key to start monitoring the power line. The PowerScope will print a complete copy of your setup, and show you the initial wave-shapes on each channel (if you have requested them in the Report Menu). Then it will print a disturbance report every time a power disturbance occurs.

5) Press the CALIBRATION key to calibrate your PowerScope. To calibrate your PowerScope, you must connect an external A-016 Precision Calibrator to the PowerScope; If you haven't connected one, the PowerScope will print its most recent calibration data.

6) Press the SELF TEST key to test the PowerScope.

(There is no more HELP!)

====================================



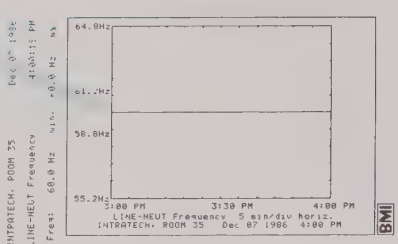
1 Single-phase

Nom. freq.: 60.0Hz

Range: 45Hz to 450Hz

Use the number keys to enter the nominal frequency of the line you are monitoring.

Typical settings are 50.0 Hz, 60.0 Hz, 400.0 Hz, or 415.0 Hz.

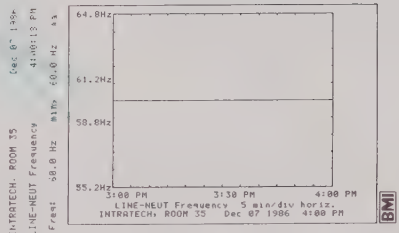


Freq. tol.: 1.2Hz

Range: 0.4Hz to 135.0Hz

Use the number keys to enter a threshold for line-frequency deviation.

The range is 0.2 to 50% of the nominal frequency, and is entered in Hertz. A typical value is 2% of the nominal frequency.



For example, if the nominal setting is 50.0 Hz,
the frequency tolerance range is 0.1 Hz (0.2%) to 25 Hz (50%).
If the frequency is 60 Hz, the frequency tolerance range is 0.1 Hz to 30 Hz.
If the frequency is 400 Hz, the frequency tolerance range is 0.8 Hz to 200 Hz.
If the frequency is 415 Hz, the frequency tolerance range is 0.8 Hz to 207 Hz.

HELP!

==========

Enter the nominal line frequency of the line you are monitoring. This provides a reference to the monitor from which it can base its measurements. Typical values are 50.0 Hz, 60.0 Hz, and 400.0 Hz. The acceptable range is 45.0 Hz to 450.0 Hz.

(Press HELP! again for general information on the Setup Menu.)

==========

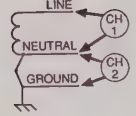
==========

Enter in Hertz the amount of line frequency deviation from nominal that you are willing to tolerate before the PowerScope reports a disturbance. The range is 0.2% to 50% of your nominal frequency setting. A typical value is 2% of your nominal frequency.

For example, if your nominal frequency setting is 60 Hz., the range is 0.1 Hz (0.2%) to 30.0 Hz (50%). The default setting for 60 Hz is 1.2 Hz (2%).

(Press HELP! again for general information on the Setup Menu.)

==========



Single-phase

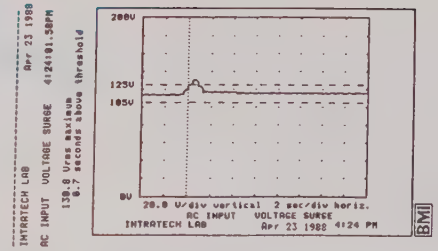
Surge volt: 125.0Vrms

Range: 1.0Vrms to 750.0Vrms

Use the number keys to enter the high-voltage threshold for line-to-neutral.

The usual value is about 10% above the nominal voltage.

The acceptable range is 1.0 Vrms to 750.0 Vrms.



This is a line-to-neutral disturbance graph.

The surge-voltage threshold also determines the full scale RMS voltage as follows:

Voltage Surge Threshold Table

Surge Threshold	Full Scale
1.0 – 6.2 Vrms	10.0 Vrms
6.3 – 12.5 Vrms	20.0 Vrms
12.6 – 25.0 Vrms	40.0 Vrms
25.1 – 62.5 Vrms	100.0 Vrms
62.6 - 125.0 Vrms	200.0 Vrms
125.1 - 166.5 Vrms	250.0 Vrms
166.6 - 250.0 Vrms	400.0 Vrms
250.1 - 750.0 Vrms	800.0 Vrms

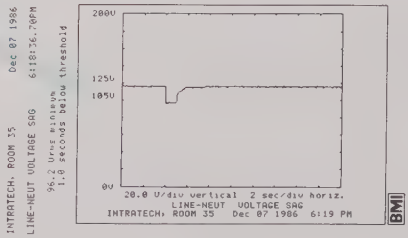
Sag volt: 105.0Vrms

Range: 0.0Vrms to 749.9Vrms

Use the number keys to enter the low voltage threshold for line-to-neutral.

The usual value is about 15% below the nominal voltage.

The acceptable range is 0.0 to 749.9 Vrms.

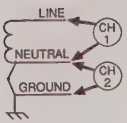


This is a line-to-neutral disturbance graph.

HELP!

```
====================================

Use the number keys to enter the
high voltage threshold.  The usual
value is about 10% above the nominal
voltage.  The acceptable range is
1.0 Vrms to 750.0 Vrms.

(Press HELP! again for general
information on the Setup Menu.)

====================================
```

```
====================================

Use the number keys to enter the low
voltage threshold.  The usual value is
about 15% below the nominal voltage.
The acceptable range is 0.0 Vrms to
749.9 Vrms.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```



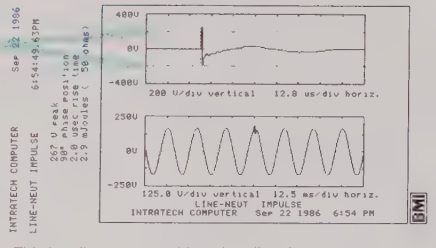
1. Single-phase

Impulse thr: 200Vpk

Range: 20Vpk to 6000Vpk

Use the number keys to enter the value of the smallest impulse you wish the PowerScope to report.

Typical thresholds are in the range of 100-250 volts. You may select any value from 20 Vpk to 6000 Vpk.



This is a line-to-neutral impulse disturbance graph.

HELP!

==========

Use the number keys to enter the value of the smallest impulse you wish the PowerScope to report. Typical thresholds are in the range of 100-250 volts. You may select any value from 20 to 6000 volts.

(Press HELP! again for more information on answering this question.)

==========

==========

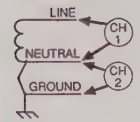
If you choose AUTO impulse ranging in the Key Operator Menu, the PowerScope will choose a full scale impulse range according to the following table:

Impulse threshold	Impulse full scale
20 Vpk - 50 Vpk	100 Vpk
51 Vpk - 100 Vpk	200 Vpk
101 Vpk - 200 Vpk	400 Vpk
201 Vpk - 400 Vpk	800 Vpk
401 Vpk - 800 Vpk	1600 Vpk
801 Vpk - 1600 Vpk	3200 Vpk
1601 Vpk - 6000 Vpk	6400 Vpk

However, if you choose MANUAL impulse ranging in the Key Operator Menu, you will be asked to select a full scale range yourself.

(Press HELP! again for general information on the Setup Menu.)

==========



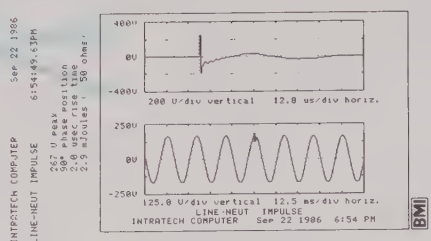
1. Single-phase

NOTE: The next question will only appear if you have Impulse Ranging in the Key Operator Menu set to MANUAL.

Imp. range: 400Vpk

Possible selections: See the following table.

Use the VALUE UP/ VALUE DOWN keys to select the full-scale impulse range for line-to-neutral.



This is a line-to-neutral impulse disturbance graph.

The selections depend on the impulse threshold, e.g. for a 20 - 24 Vpk threshold, there are 2 full-scale ranges available, 100 or 200 volts full-scale.

Manual Impulse Ranging Table

Impulse Threshold	Available Full-Scale Ranges
20-24 Vpk	+/- 100 or 200 volts full-scale
24-49 Vpk	+/- 100, 200 or 400 volts full-scale
50 Vpk	+/- 100, 200, 400 or 800 volts full-scale
51-99 Vpk	+/- 200, 400 or 800 volts full-scale
100 Vpk	+/- 200, 400, 800 or 1600 volts full-scale
101-199 Vpk	+/- 400, 800 or 1600 volts full-scale
200 Vpk	+/- 400, 800, 1600 or 3200 volts full-scale
201-399 Vpk	+/- 800, 1600 or 3200 volts full-scale
400 Vpk	+/- 800, 1600, 3200 or 6400 volts full-scale
401-800 Vpk	+/- 1600, 3200 or 6400 volts full-scale

If you selected AUTO Impulse Ranging in the Key Operator Menu (or plan to), the full-scale impulse range will be selected for you as follows:

Automatic Impulse Ranging Table

If Impulse Threshold selected in previous question is between...	The Impulse Range will set automatically to...
20 - 50 volts	+/- 100 volts
51 - 100 volts	+/- 200 volts
101 - 200 volts	+/- 400 volts
201 - 400 volts	+/- 800 volts
401 - 800 volts	+/- 1600 volts
801 - 1600 volts	+/- 3200 volts
1601- 6000 volts	+/- 6400 volts

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to select the full scale impulse range. (If you want the PowerScope to choose a range for you automatically, use the Key Operator menu to select AUTO impulse ranging. The PowerScope will automatically select a range that will give you a good compromise between resolution and dynamic range.)

(Press HELP! for more information on selecting full scale ranges.)

==========

==========

The full scale impulse ranges are:

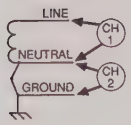
100 Vpk
200 Vpk
400 Vpk
800 Vpk
1600 Vpk
3200 Vpk
6400 Vpk

To preserve resolution, the PowerScope will not allow you to select a full scale range that is less than two times your impulse threshold or greater than 16 times your impulse threshold:

Full scale	Acceptable thresholds
100 Vpk	20 Vpk - 50 Vpk
200 Vpk	20 Vpk - 100 Vpk
400 Vpk	20 Vpk - 200 Vpk
800 Vpk	50 Vpk - 400 Vpk
1600 Vpk	100 Vpk - 800 Vpk
3200 Vpk	200 Vpk - 1600 Vpk
6400 Vpk	400 Vpk - 6000 Vpk

(Press HELP! again for general information on the Setup Menu.)

==========



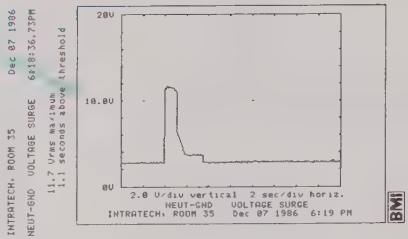
1. Single-phase

Neut-Gnd: 10.0 Vrms

Range: 0.1 Vrms to 99.9 Vrms

Use the number keys to enter the surge voltage threshold for neutral-to-ground.

You may select any value from 0.1 Vrms to 99.9 Vrms. (Typical thresholds range between 1.0 and 10.0 Vrms.)



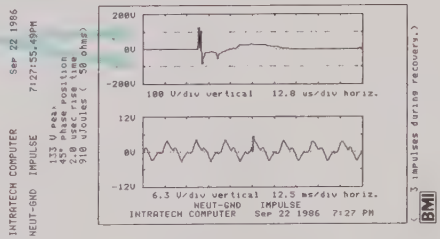
This is a neutral-to-ground surge graph.

N-G Imp thr: 100Vpk

Range: 20 Vpk to 6000 Vpk

Use the number keys to enter the value of the smallest neutral-to-ground impulse you want the PowerScope to graph.

Typical thresholds range between 50-250 volts. You may select any value from 20 volts to 6000 volts.

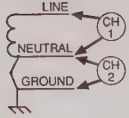


This is a neutral-to-ground impulse graph.

HELP!

```
====================================

Use the number keys to enter the
acceptable ac voltage difference
between the neutral and ground lines
being monitored by the PowerScope.
Typical thresholds are in the range
of 1.0-10.0 Vrms.  You may select any
value from 0.1 Vrms to 99.9 Vrms.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```

```
====================================

Use the number keys to enter the value
of the smallest impulse you wish the
PowerScope to report. Typical
thresholds are in the range of
100-250 volts.  You may select any
value from 20 to 6000 volts.

(Press HELP! again for more infor-
mation on answering this question.)

====================================
```



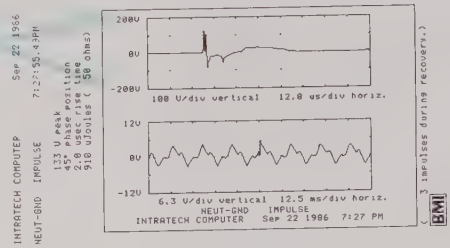
1: Single-phase

NOTE: You'll only get the next question if you have Impulse Ranging in the Key Operator Menu set to MANUAL.

N-G imp. range: 200Vpk

Possible selections: See the following table.

Use the VALUE UP/ VALUE DOWN keys to select the full-scale impulse range for neutral-to-ground.



This is a neutral-to-ground impulse graph.

The selections depend on the impulse threshold, e.g. for a 20-24 Vpk threshold, there are 2 full-scale ranges available, 100 or 200 volts full-scale.

Manual Impulse Ranging Table

Impulse Threshold	Available Full-Scale Ranges
20-24 Vpk	+/- 100 or 200 volts full-scale
24-49 Vpk	+/- 100, 200 or 400 volts full-scale
50 Vpk	+/- 100, 200, 400 or 800 volts full-scale
51-99 Vpk	+/- 200, 400 or 800 volts full-scale
100 Vpk	+/- 200, 400, 800 or 1600 volts full-scale
101-199 Vpk	+/- 400, 800 or 1600 volts full-scale
200 Vpk	+/- 400, 800, 1600 or 3200 volts full-scale
201-399 Vpk	+/- 800, 1600 or 3200 volts full-scale
400 Vpk	+/- 800, 1600, 3200 or 6400 volts full-scale
401-800 Vpk	+/- 1600, 3200 or 6400 volts full-scale

If you selected AUTO Impulse Ranging in the Key Operator Menu (or plan to) the full-scale impulse range will be selected for you according to the Automatic Impulse Table shown below:

Automatic Impulse Ranging Table

If Impulse Threshold selected in previous question is between...	The Impulse Range will set automatically to...
20 - 50 volts	+/- 100 volts
51 - 100 volts	+/- 200 volts
101 - 200 volts	+/- 400 volts
201 - 400 volts	+/- 800 volts
401 - 800 volts	+/- 1600 volts
801 - 1600 volts	+/- 3200 volts
1601- 6000 volts	+/- 6400 volts

HELP!

Use the VALUE UP/VALUE DOWN keys to select the full scale impulse range. (If you want the PowerScope to choose a range for you automatically, use the Key Operator menu to select AUTO impulse ranging. The PowerScope will automatically select a range that will give you a good compromise between resolution and dynamic range.)

(Press HELP! for more information on selecting full scale ranges.)

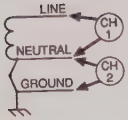
The full scale impulse ranges are:

100 Vpk
200 Vpk
400 Vpk
800 Vpk
1600 Vpk
3200 Vpk
6400 Vpk

To preserve resolution, the PowerScope will not allow you to select a full scale range that is less than two times your impulse threshold or greater than 16 times your impulse threshold:

Full scale	Acceptable thresholds
100 Vpk	20 Vpk - 50 Vpk
200 Vpk	20 Vpk - 100 Vpk
400 Vpk	20 Vpk - 200 Vpk
800 Vpk	50 Vpk - 400 Vpk
1600 Vpk	100 Vpk - 800 Vpk
3200 Vpk	200 Vpk - 1600 Vpk
6400 Vpk	400 Vpk - 6000 Vpk

(Press HELP! again for general information on the Setup Menu.)

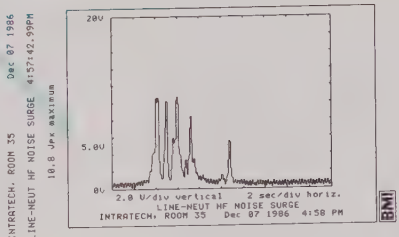


1. Single-phase

Hi. freq. noise: 5.0V

Range: 1.0 V to 19.9 V

Use the number keys to enter the high-frequency noise disturbance threshold (measured in peak-to-peak volts).



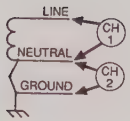
This is a high-frequency noise disturbance graph.

This threshold will be used for line-to-neutral and neutral-to-ground. A typical threshold is 5.0 Vpk. The acceptable range is 1.0 Vpk to 19.9 Vpk.

NOTE: If you are using probes for environmental monitoring there will be additional questions. See Chapter 6 (page 6-2) for an explanation of environmental thresholds.

HELP!

```
=====================================

Use the number keys to enter the
high frequency noise disturbance
threshold (measured in peak-to-peak
volts).  A typical threshold is
5.0 Vpk.  The acceptable range is
1.0 Vpk to 19.9 Vpk.

(Press HELP! again for general infor-
mation on the Setup Menu.)

=====================================
```



1 Single-phase

The Report Menu lets you choose the graphs and strip charts your PowerScope prints. For a complete discussion of graphs and summary reports, see Appendix A.

Quick Guide

1. Press the REPORT MENU key.

2. Use the VALUE UP/VALUE DOWN keys to answer the questions in the menu.

3. Press the down arrow to go to the next question.

4. Press the HELP! key if you want further explanation about the questions.

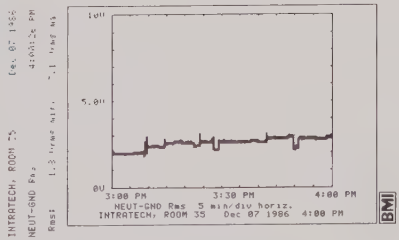
Press the REPORT MENU key now.

If you get the following message in the display, it's because the PowerScope has strip charts from the previous monitoring period.

Summary rpts: Print

Possible selections: Print
Clear

Use the VALUE UP/ VALUE DOWN keys to choose whether you want the pending strip charts.



This is a 1-Hour Summary Strip Chart.

If you want them printed then erased, position PRINT in the display, then press the down arrow. If you want them erased immediately, position CLEAR in the display, then press the down arrow.

Then press the REPORT MENU key again and proceed.

HELP!

==========

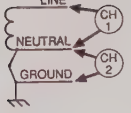
Use the VALUE UP/VALUE DOWN keys to select PRINT or CLEAR and then use the DOWN ARROW key to enter the menu you have selected.

If you select PRINT, the summary data and strip charts that have been gathered so far by the PowerScope will be printed and then reset. If you select CLEAR, all of the summary data and strip charts will be reset without printing.

If you don't want to lose any summary data, you may return to the Monitor mode by pressing the MONITOR key.

(There is no more HELP!)

==========



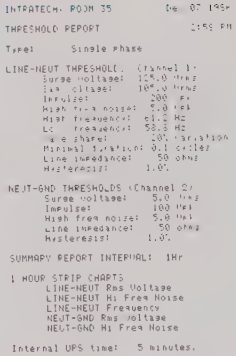
1: Single phase

Threshold report: On

Selections: On
Off

Use the VALUE UP/ VALUE DOWN keys to turn the Threshold Report on or off.

Your PowerScope prints the Threshold Report after you press the MONITOR key. The Threshold Report shows all the current settings. Generally, you should leave this report on.

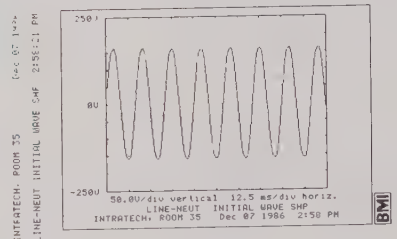


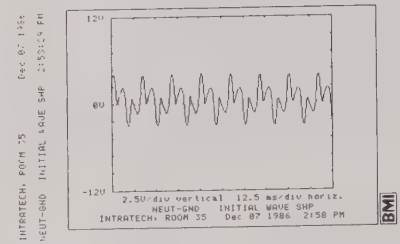
Initial waves: On

Selections: On
Off

Use the VALUE UP/ VALUE DOWN keys to turn the initial waveshape graphs on or off.

Your PowerScope prints initial waveshape graphs after the Threshold Report. These graphs show the initial condition of the sine waves. Generally, you should leave these graphs on.





HELP!

==========

Use the VALUE UP/VALUE DOWN keys to turn the Threshold Report on or off. This report should normally be left on.

(Press HELP! again for more information on Threshold Reports).

==========

==========

The Threshold Report is the list of thresholds and settings your PowerScope can print automatically before it begins monitoring.

(If you turn the Threshold Report on now, you can still omit it when you begin monitoring by pressing the MONITOR key followed immediately by the UP ARROW key.)

(Press HELP! again for general information on the Report Menu).

==========

==========

Use the VALUE UP/VALUE DOWN keys to turn the Initial Waveshape Report on or off. This report should normally be left on.

(Press HELP! again for more information on the Initial Waveshape Report).

==========

The Report Menu contains questions that define the type of summary strip charts you would like, and over what time duration you would like them.

The questions in the Report Menu vary depending on the type of power each channel is monitoring, and if you have probes plugged into the environmental channels.

(Press HELP! again for general information on the operating sequence.)

==========

==========

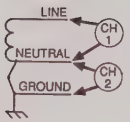
The usual sequence for operating the PowerScope monitor is:

1) Press the SETUP MENU key and answer the questions. To go on to the next question, press the Down Arrow.

2) Connect the monitor to the power line. (See the HELP! message in the Setup Menu for the 'TYPE:' question.)

3) Press the MONITOR key to monitor the power line. Your reports will be printed automatically.

(Press HELP! again for general information on the six modes of operation.)

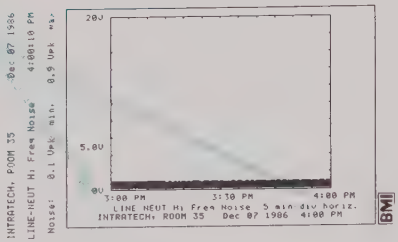


1: Single-phase

Strip charts: 1Hr

Selections: 24Hr
12Hr
6Hr
3Hr
1Hr
Off

Use the VALUE UP/ VALUE DOWN keys to set the strip chart interval.



This is a Strip Chart.

```
INTRATECH, ROOM 35          Dec 07 1986

STRIP CHART REPORT                4:00 PM
 From  3:00 PM  To  4:00 PM

LINE-NEUT  (Channel 1)
 Rms:    111.3 Vrms min.  120.1 Vrms max
 Noise:    0.1 Vpk  min.    0.9 Vpk  max
 Freq:    60.0 Hz   min.   60.0 Hz   max
 Inp:        0 counted

NEUT-GND  (Channel 2)
 Rms:      1.8 Vrms min.    3.1 Vrms max
 Noise:    0.7 Vpk  min.    1.3 Vpk  max
 Inp:        0 counted
```

This is a Summary Strip Chart Report.

If you choose:

24 hr – strip charts will be printed every 24 hours at midnight.
12 hr – strip charts will be printed every 12 hours beginning at 12:00.
6 hr – strip charts will be printed every 6 hours beginning at 6:00.
3 hr – strip charts will be printed every 3 hours beginning at 3:00.
1 hr – strip charts will be printed every hour on the hour.
Off – no long-term summary information will be printed.

NOTE: Whatever strip chart interval you choose here will appear in the forthcoming questions.

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to select the time interval between printing strip charts and summary reports.

Possible selections are: 24 hours, 12 hours, 6 hours, 3 hours, 1 hour, or OFF. The interval that you choose impacts the choices offered you in the next series of questions.

(Press HELP! for more information on selecting strip chart summary reports).

==========

==========

If you choose, for example, 12-hour strip chart summaries, your choices in the next questions regarding individual strip chart summary reports will include 12-hour strip charts. (If you choose 3-hour strip charts here, your choices in the next questions will include 3-hour strip charts, and so on.)

(Press HELP! for general information on the Setup Menu.)

==========

The PowerScope monitor can be in one of six modes:

1) Press the SETUP MENU key to program the Setup Menu. Use the up arrow and the down arrow key to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu. (You may want to press 'HELP!' when you have selected the type of power line you are going to monitor. This will give you installation instructions.)

   By pressing the SETUP MENU key, then immediately pressing the UP ARROW key, you will enter the Key Operator Menu. This menu will give you control of the detailed operation of the PowerScope.

2) Press the STATUS key to print the Status Report. This report tells you the present voltage, frequency, and noise on each of the channels. This report can be especially useful when you're trying to set the thresholds correctly. It's also useful for checking to see if you've installed the monitor correctly.

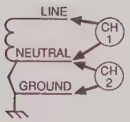
3) Press the REPORT MENU key to enter the Report menu. Use the up arrow and the down arrow to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu.

4) Press the MONITOR key to start monitoring the power line. The PowerScope will print a complete copy of your setup, and show you the initial waveshapes on each channel (if you have requested them in the Report Menu). Then it will print a disturbance report every time a power disturbance occurs.

5) Press the CALIBRATION key to calibrate your PowerScope. To calibrate your PowerScope, you must connect an external A-016 Precision Calibrator to the PowerScope; If you haven't connected one, the PowerScope will print its most recent calibration data.

6) Press the SELF TEST key to test the PowerScope.

(There is no more HELP!)

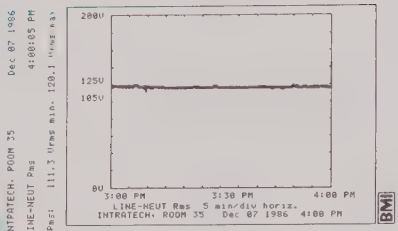


Single-phase

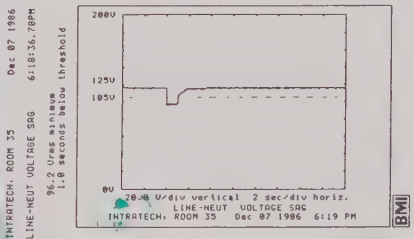
LINE-NEUT RMS: Both

Selections: Both
1 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the line-to-neutral Rms signal.



1-Hr strip chart: line-to-neutral Rms.



Graph: line-to-neutral Rms disturbance.

If you choose:

1-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

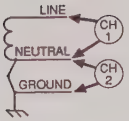
Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Both - your PowerScope will print both strip charts and graphs.

Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

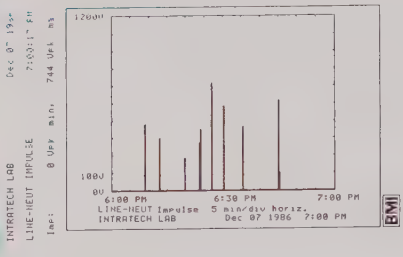
```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```



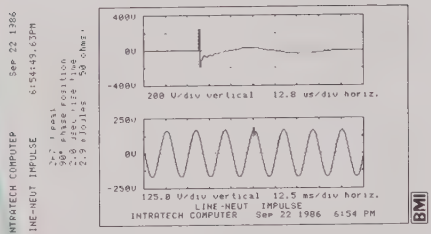
1. Single phase

LINE-NEUT Imp: Both

Selections: Both
1 Hr
Graph
Off



1-Hr strip chart: impulse.



Graph: impulse.

If you choose:

Both - your PowerScope will print both strip charts and graphs.

1-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

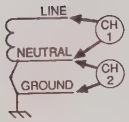
Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Off - no disturbance graphs or strip charts will be printed for this signal; however the maximum reading of this signal will be reported textually in the summary reports.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

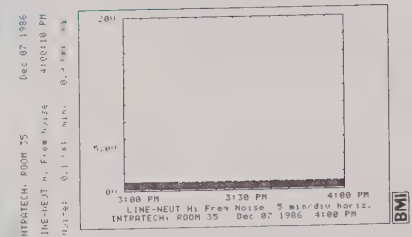

1 Single-phase
2 Dual-Line Power
3 Three-Phase Wye
4 Three-Phase Delta
5 Probes and Accessories
6 Front Panel Menu
7 Key Overview Menu
8 Communications Menu
10 Operation
11 Loading Paper
12 Troubleshooting
13 Specifications
14 Glossary
15 Recommended Thresholds
Index
Your Comments Please



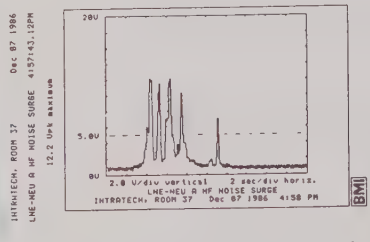
LINE-NEUT HFN: Both

Selections: Both
1 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the line-to-neutral high-frequency noise signal.



1-Hr strip chart: line-to-neutral high-frequency noise.



Graph: line-to-neutral high frequency noise.

If you choose:

Both - your PowerScope will print both strip charts and graphs.

1-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Off - no disturbance graphs or strip charts will be printed for this signal, however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to select the report(s) you'd like for this signal.

You have four choices:

Both -
Your PowerScope will print both a strip chart summary and a disturbance graph of this signal.

Strip Chart Interval -
You will get only a strip chart summary of this signal, without disturbance graphs.

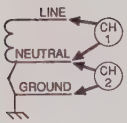
GRAPH -
Your PowerScope will graph all disturbances for this signal but will not print a strip chart for this signal.

OFF -
Your PowerScope will print neither disturbance graphs nor a strip chart, but the minimum and maximum readings of this signal will still be printed in the summary reports.

If you turned strip charts off at the beginning of the Report Menu, you will not have the choice of a strip chart summary in this question.

(Press HELP! again for general information on the Report Menu.)

==========

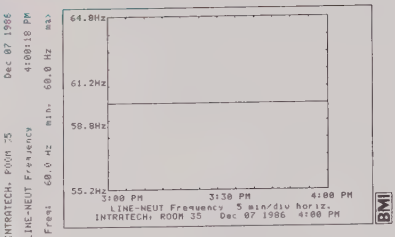


1 Single-phase

LINE-NEUT FREQ: Both

Selections: Both
1 Hr
Text
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the line-to-neutral frequency signal.



1-Hr strip chart: line-to-neutral frequency.

```
INTRATECH. ROOM 35          Dec 07 1986
LINE-NEUT LOW FREQ.      5:08:04.51PM
     Frequency below:         59.5 Hz


--- -------- ------- ----------------
INTRATECH. ROOM 35          Dec 07 1986
LINE-NEUT LOW FREQ END   5:08:07.32PM
     Minimum frequency:       57.4Hz
```

Text report: line-to-neutral frequency.

If you choose:

Both - your PowerScope will print both strip charts and text disturbance reports.

1-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print text disturbance reports.

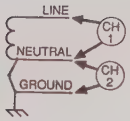
Text - your PowerScope will print text disturbance reports of this signal, but won't print strip charts.

Off - no text disturbance reports or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a textual
     disturbance reports of this
     signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance reports.

TEXT -
     Your PowerScope will print a
     textual report of all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither textual reports nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu,
you will not have the choice of
strip chart summaries in this
question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

1. Single-phase

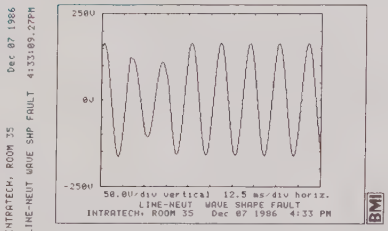


LINE-NEUT Wave: On

Selections: On
Off

Use the VALUE UP/ VALUE DOWN keys to turn line-to-neutral waveshape fault graphs on or off.

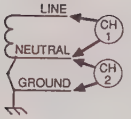
Generally, you will leave this report on.



This is a line-to-neutral waveshape fault graph.

HELP!

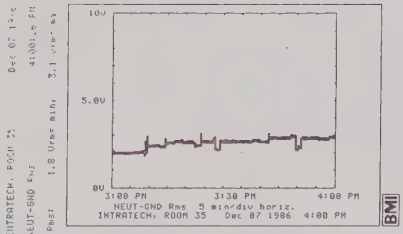
```
====================================

Use the VALUE UP/VALUE DOWN keys to
turn on or off the Waveshape fault
disturbance reporting for this signal.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```



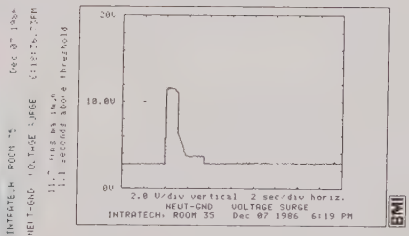
NEUT-GND Rms: Both

Selections: Both
1 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the neutral-to-ground Rms signal.



1-Hr strip chart: neutral-to-ground Rms.



Graph: neutral-to-ground surge.

If you choose:

Both - your PowerScope will print both strip charts and graphs.

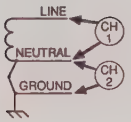
1-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

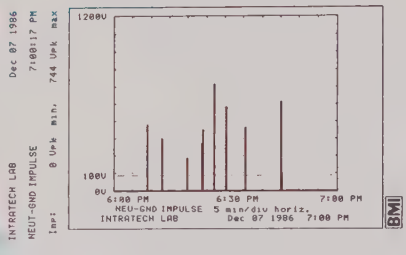


1 Single-phase

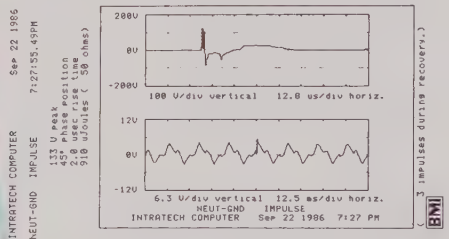
NEUT-GND Imp: Both

Selections: Both
1 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for neutral-to-ground impulses.



1-Hr strip chart: neutral-to-ground impulse.



Graph: impulse.

If you choose:

Both - your PowerScope will print both strip charts and graphs.

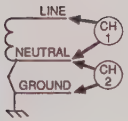
1-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Off - no disturbance graphs or strip charts will be printed for this signal; however the maximum reading of this signal will be reported textually in the summary reports.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

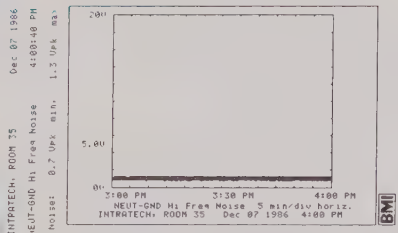


1 Single-phase

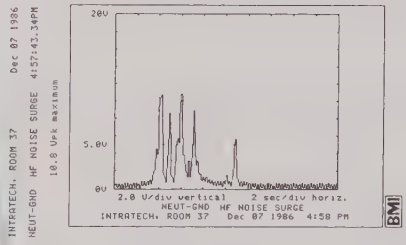
NEUT-GND HFN: Both

Selections: Both
1 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the neutral-to-ground high-frequency noise signal.



1-Hr strip chart: neutral-to-ground high-frequency noise.



Graph: neutral-to-ground high-frequency noise.

If you choose:

Both - your PowerScope will print both strip charts and graphs.

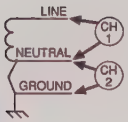
1-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

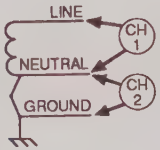
Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```



Part 3 discusses how to connect your PowerScope for monitoring single-phase power.



To monitor both lines (phase-to-neutral and neutral-to-ground) of single-phase power requires two channels.

Using the single phase measuring cable:

1. Connect the green (ground) connector to ground.

2. Connect the red safety connector to Channel 1 red (positive).

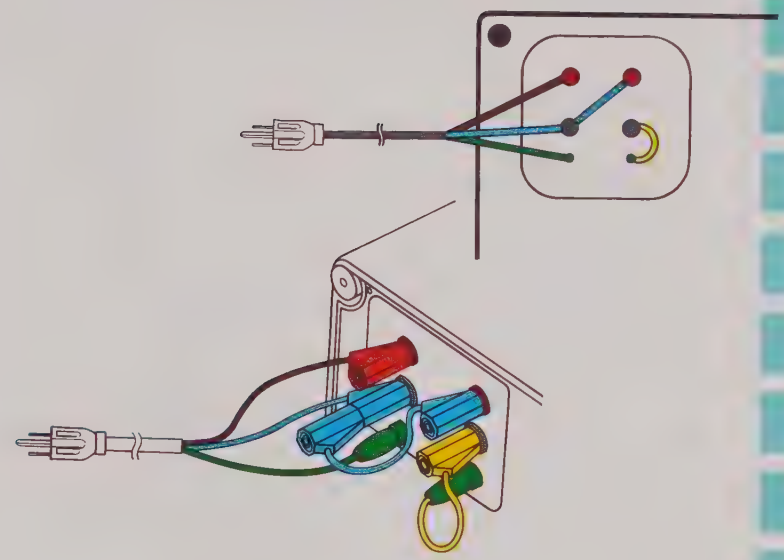
3. Connect the black safety connector to a blue jumper connected into Channel 1 black (negative).

4. Connect the other end of the blue jumper into Channel 2 red (positive).

5. Connect another blue jumper cable from Channel 2 black (negative) to ground.

WARNING
You are working with high voltages that cause burns and lethal shocks. Connect the safety earth ground first. USE STANDARD SAFETY PRECAUTIONS.

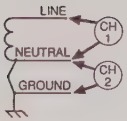
HELP!



Press the STATUS key to get a printout verifying that you've connected correctly, and that your initial readings are within the thresholds you've set.

```
INTRATECH, ROOM 35          Dec 07 1986

STATUS REPORT                    4:29 PM

LINE-NEUT (Channel 1):
   Voltage:      115.5 - 117.2 Vrms
   Frequency:     60.0 -  60.0 Hz
   Hi freq noise:  1.0 -   2.1 Vpk

NEUT-GND (Channel 2):
   Voltage:        2.8 -   2.9 Vrms
   Hi freq noise:  1.0 -   1.2 Vpk

BATTERY CONDITION
   Voltage:    11.8 Vdc
   State:       Charged
```

Press the MONITOR key to begin monitoring.



Summary of Setup menu and Report menus:
Menu prompts appear in the order shown. To scroll through the questions, press the Up Arrow or the Down Arrow. The indented options are chosen by pressing the VALUE UP/VALUE DOWN keys, and the range values (in parenthesis) are entered using the keypad.

Summary Reports: Print
Clear

Site: BMI 2400 SITE
(Any 15 character name)

Type: Single Phase
Dual 1-phase
3-phase delta
3-phase wye
Ind. Channels

Nom. freq.: 60.0 Hz
(45Hz-440Hz)

Freq. tol.: 1.2 Hz
(0.2-50% of nominal)

Surge volt: 125.0Vrms
(1.0-750.0Vrms)

Sag volt: 105.0Vrms
(0.0-749.0Vrms)

Impulse thr: 200Vpk
(20Vpk-6000Vpk)

[Imp. range: 400Vpk]*
(100Vpk-6400Vpk)

Neut-Gnd: 5.0 Vrms
(0.1-99.9Vrms)

N-G Imp thr: 100.0Vpk
(20.0-6000.0Vpk)

[N-G Imp. range: 200Vpk]*
(100.0-6400.0Vpk)

Hi.freq.noise: 10.0V
(1.0-19.9V)

End of setup menu.

* Appears only if Inpulse Ranging is set to MANUAL in the Key Operator menu.

Report Menu

Summary Reports: Print
Clear

Threshold report: On
Off

Initial Waves: On
Off

Strip charts: 24Hr
12Hr
6Hr
3Hr
1Hr
Off

LINE-NEUT Rms: Both
Strip chart interval
Graph
Off

LINE-NEUT Imp: Both
Strip chart interval
Graph
Off

LINE-NEUT HFN: Both
Strip chart interval
Graph
Off

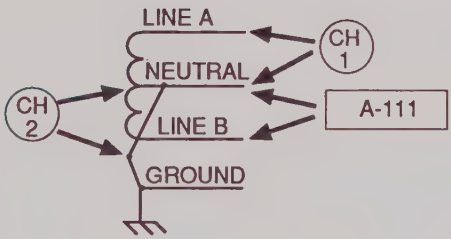
LINE-NEUT Freq.: Both
Strip chart inteval
Text
Off

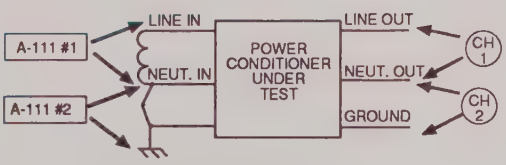
LINE-NEUT Wave: On
Off

NEUT-GND Rms: Both
Strip chart interval
Graph
Off

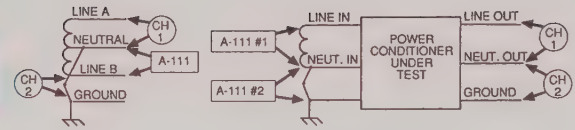
NEUT-GND Imp: Both
Strip chart interval
Graph
Off

Chapter 2
Dual-One Phase





2 Dual-One Phase
Three-Phase Delta



You can use this chapter for monitoring split single-phase power, or for monitoring the input and output of a single-phase power conditioner. For split single-phase power, you will need a BMI AC/DC/Impulse Probe (A-111) to monitor phase 2. If you want to set up your monitoring in any other way than is described here, choose independent channels (Page 5-2). For monitoring the input and output of a single-phase power conditioner, you will need two A-111 probes.

Quick Guide to the Setup Menu

1. Press the SETUP MENU key.

2. Answer the questions in the menu using the VALUE UP/ VALUE DOWN keys or the number keypad.

3. Press the down arrow key to go on to the next question.

4. Press the HELP! key if you want further explanation about the question or on what to do next.

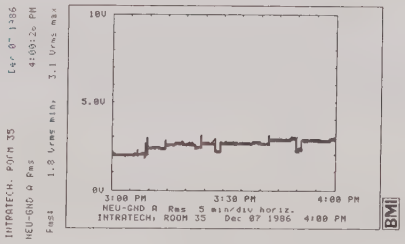
Press the SETUP MENU key now.

If you get the following message in the display, it's because the PowerScope has strip charts from a previous monitoring period:

Summary rpts: Print

Possible selections: Print
Clear

Use the VALUE UP/ VALUE DOWN keys to choose whether you want the pending strip charts.



This is a summary strip chart.

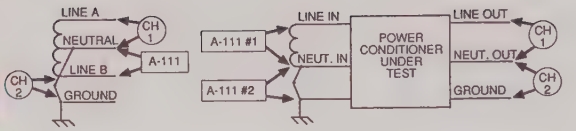
If you want them printed then erased, position PRINT in the display, then press the down arrow. If you want them erased immediately, position CLEAR in the display, then press the down arrow.

Then press the SETUP MENU key again and proceed.

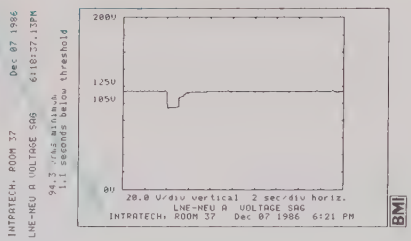
HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select PRINT or CLEAR and then
use the DOWN ARROW key to enter
the menu you have selected.

If you select PRINT, the summary data
and strip charts that have been
gathered so far by the PowerScope will
be printed and then reset. If you
select CLEAR, all of the summary
data and strip charts will be reset
without printing.

If you don't want to lose any summary
data, you may return to the Monitor
mode by pressing the MONITOR key.

(There is no more HELP!)

====================================
```

2. Dual-One Phase



Site: INTRATECH, ROOM 37



Use the number keys to enter the name of the site where you are monitoring.

Use the left and right arrow keys to move the flashing cursor.

Use the number keys to enter both letters and numbers; for example, to enter the letter "K", press the 5JKL key 3 times. On the first press, a 5 will appear, on the second a J, and on the third, a K will appear.

Now move the flashing cursor to the next position by pressing the right arrow key. Press the 0 SPACE key twice to enter a space. Press the down arrow key to go on to the next question.

==========

You may enter up to 20 characters from the keyboard to identify the site that you are monitoring.

Use the left and right arrow keys to move the flashing cursor.

Use the number keys to enter both letters and numbers. For example, to enter the letter 'B', push the '2ABC' key three times.

(Press HELP! again for general information on the Setup Menu.)

==========

==========

The Setup Menu contains questions that define the operating parameters of your PowerScope. Specifically, it asks you to name the monitoring site, state what type of power each channel will monitor, and specify thresholds for each measurement.

The questions in the Setup Menu change automatically depending on what type of power you assign each channel and if you have probes plugged into the environmental channels.

(Press HELP! again for general information on the operating sequence.)

==========

==========

The usual sequence for operating the PowerScope monitor is:

1) Press the SETUP MENU key and answer the questions. To go on to the next question, press the Down Arrow.

2) Connect the monitor to the power line. (See the HELP! message in the Setup Menu for the 'TYPE:' question.)

3) Press the MONITOR key to monitor the power line. Your reports will be printed automatically.

(Press HELP! again for general information on the six modes of operation.)

==========

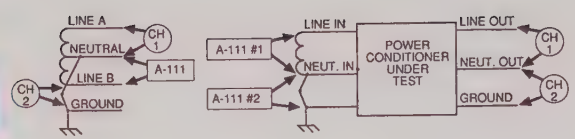
The PowerScope monitor can be in one of six modes:

1) Press the SETUP MENU key to program the Setup Menu. Use the up arrow and the down arrow key to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu. (You may want to press 'HELP!' when you have selected the type of power line you are going to monitor. This will give you installation instructions.)

   By pressing the SETUP MENU key, then immediately pressing the UP ARROW key, you will enter the Key Operator Menu. This menu will give you control of the detailed operation of the PowerScope.

Continued on page 2-7.

2. Dual-One Phase

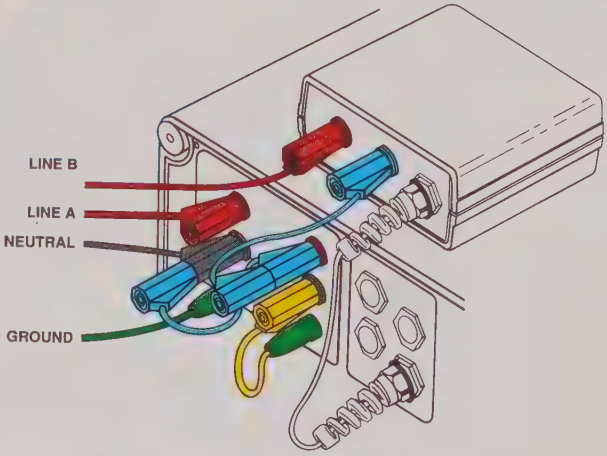


Type: Dual 1-phase

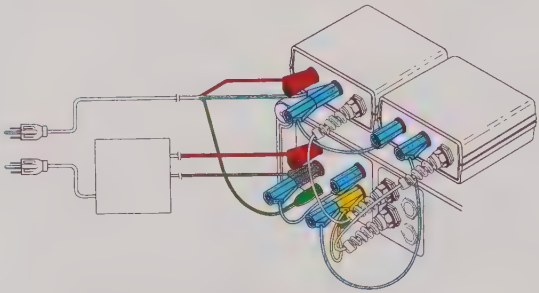
Selections: Single Phase
Dual 1-phase
3 phase delta
3 phase wye
Ind. channels

Use the VALUE UP/ VALUE DOWN keys to select Dual 1-phase power.

You will need an AC/DC Impulse probe to monitor Phase 2.



Split single-phase connection. One BMI A-111 AC/DC/Impulse probe is required with the PowerScope.



Power conditioner evaluation connection. Two BMI A-111 AC/DC/Impulse probes are required.

Press the HELP! key for information on connecting your PowerScope to Dual-One Phase power, or see Part 3 of this chapter on page 2-60.

WARNING
You are working with high voltages that cause burns and lethal shocks. Connect the safety earth ground first. USE STANDARD SAFETY PRECAUTIONS.

HELP!

Continued from page 2-5.

Select '1 phase' to monitor a single phase source.

To install the PowerScope on a single phase line, make the following connections:

Channel 1 GREEN terminal: SAFETY GROUND

Channel 1 Red terminal: Phase
Channel 1 Black terminal: Neutral

Channel 2 Red terminal: Neutral
Channel 2 Black terminal: Ground

(Press HELP! again for general information on the Setup Menu.)

2) Press the STATUS key to print the Status Report. This report tells you the present voltage, frequency, and noise on each of the channels. This report can be especially useful when you're trying to set the thresholds correctly. It's also useful for checking to see if you've installed the monitor correctly.

3) Press the REPORT MENU key to enter the Report menu. Use the up arrow and the down arrow to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu.

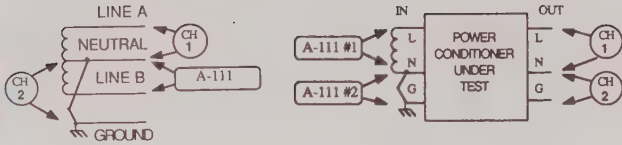
4) Press the MONITOR key to start monitoring the power line. The PowerScope will print a complete copy of your setup, and show you the initial waveshapes on each channel (if you have requested them in the Report Menu). Then it will print a disturbance report every time a power disturbance occurs.

5) Press the CALIBRATION key to calibrate your PowerScope. To calibrate your PowerScope, you must connect an external A-016 Precision Calibrator to the PowerScope; If you haven't connected one, the PowerScope will print its most recent calibration data.

6) Press the SELF TEST key to test the PowerScope.

(There is no more HELP!)

Dual One Phase

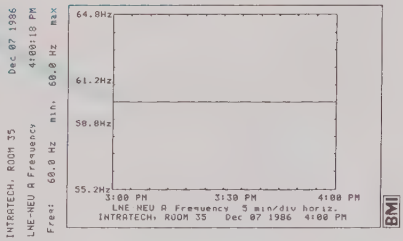


Nom. freq.: 60.0Hz

Range: 45.0Hz to 450Hz

Use the number keys to enter the nominal frequency of the line you are monitoring.

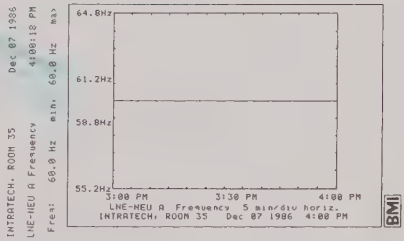
Typical values are 50.0 Hz, 60.0 Hz, 400.0 Hz, and 415.0 Hz.



Range: 0.4Hz to 135.0Hz

Use the number keys to enter a threshold for line-frequency deviation.

The range is 0.2 to 50% of the nominal frequency, and is entered in Hertz. A typical value is 2% of the nominal frequency.

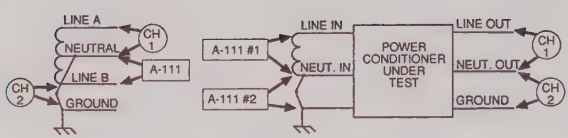


For example, if the nominal setting is 50.0 Hz, the frequency tolerance range is 0.1 Hz (0.2%) to 25 Hz (50%). If the frequency is 60 Hz, the frequency tolerance range is 0.1 Hz to 30 Hz. If the frequency is 400 Hz, the frequency tolerance range is 0.8 Hz to 200 Hz. If the frequency is 415 Hz, the frequency tolerance range is 0.8 Hz to 207 Hz.

HELP!

```
====================================

Enter the nominal line frequency of
the line you are monitoring.  This
provides a reference to the monitor
from which it can base its measure-
ments. Typical values are 50.0 Hz,
60.0 Hz, and 400.0 Hz.  The
acceptable range is 45.0 Hz to
450.0 Hz.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```

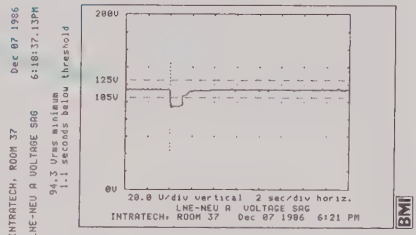
```
====================================

Enter in Hertz the amount of line
frequency deviation from nominal that
you are willing to tolerate before the
PowerScope reports a disturbance. The
range is 0.2% to 50% of your nominal
frequency setting.   A typical value
is 2% of your nominal frequency.

For example, if your nominal
frequency setting is 60 Hz., the range
is 0.1 Hz (0.2%) to 30.0 Hz (50%).
The default setting for 60 Hz is
1.2 Hz (2%).

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```



Surge volt: 125.0 Vrms

Range: 1.0 Vrms to 750.0 Vrms

Use the number keys to enter the high-voltage threshold for line-to-neutral.



The usual value is about 10% above the nominal voltage. The acceptable range is 1.0 Vrms to 750.0 Vrms. The surge voltage threshold also determines the full-scale RMS voltage as follows:

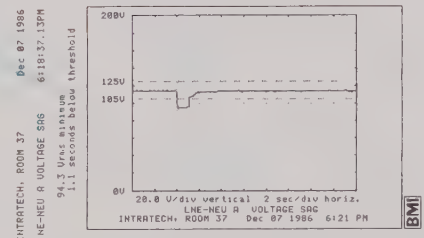
Voltage Surge Threshold Table

Surge Threshold	Full-Scale
1.0 - 14.0 Vrms	20.0 Vrms
15.0 - 74 Vrms	150.0 Vrms
75.0 - 149.0 Vrms	300.0 Vrms
150.0 - 750.0 Vrms	800.0 Vrms

Sag volt: 105.0 Vrms

Range: 0.0 Vrms to 749.9 Vrms

Use the number keys to enter the low-voltage threshold for line-to-neutral phase.

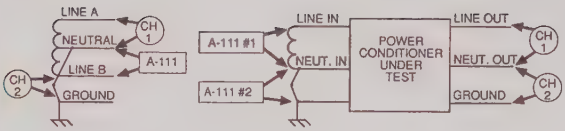


The usual value is about 15% below the nominal voltage. The acceptable range is 0.0 to 749.9 Vrms.

HELP!

```
=====================================

Use the number keys to enter the
high voltage threshold.  The usual
value is about 10% above the nominal
voltage.  The acceptable range is
1.0 Vrms to 750.0 Vrms.

(Press HELP! again for general
information on the Setup Menu.)

=====================================
```

```
=====================================

Use the number keys to enter the low
voltage threshold.  The usual value is
about 15% below the nominal voltage.
The acceptable range is 0.0 Vrms to
749.9 Vrms.

(Press HELP! again for general infor-
mation on the Setup Menu.)

=====================================
```

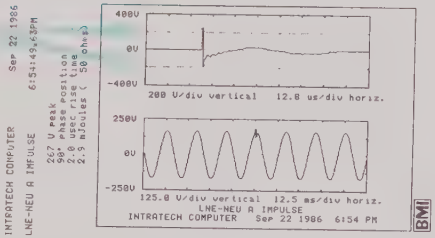


Impulse thr: 200 Vpk

Range: 20 Vpk to 6000 Vpk

Use the number keys to enter the value of the smallest impulse the PowerScope should report on line-to-neutral A.

Typical thresholds are 100-250 volts. You may select any value from 20 Vpk to 6000 Vpk.



Line-to-neutral A impulse graph.

HELP!

==========

Use the number keys to enter the value of the smallest impulse you wish the PowerScope to report. Typical thresholds are in the range of 100-250 volts. You may select any value from 20 to 6000 volts.

(Press HELP! again for more information on answering this question.)

==========

==========

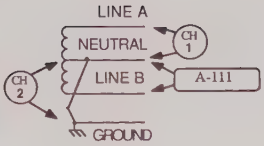
If you choose AUTO impulse ranging in the Key Operator Menu, the PowerScope will choose a full scale impulse range according to the following table:

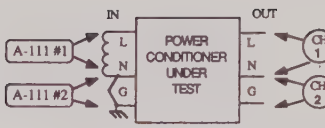
Impulse threshold	Impulse full scale
20 Vpk - 50 Vpk	100 Vpk
51 Vpk - 100 Vpk	200 Vpk
101 Vpk - 200 Vpk	400 Vpk
201 Vpk - 400 Vpk	800 Vpk
401 Vpk - 800 Vpk	1600 Vpk
801 Vpk - 1600 Vpk	3200 Vpk
1601 Vpk - 6000 Vpk	6400 Vpk

However, if you choose MANUAL impulse ranging in the Key Operator Menu, you will be asked to select a full scale range yourself.

(Press HELP! again for general information on the Setup Menu.)

==========



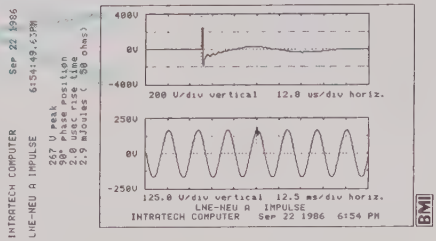


NOTE: The next question will only appear if you have Impulse Ranging in the Key Operator Menu set to MANUAL.

Imp. range: 400 Vpk

Possible selections: See table below.

Use the VALUE UP/ VALUE DOWN keys to select the full-scale impulse range for line-to-neutral A.



Line-to-neutral A impulse graph.

The selections depend on the impulse threshold, e.g. for a 20-24 Vpk threshold, there are 2 full-scale ranges availabe, 100 or 200 volts full-scale.

Manual Impulse Ranging Table

Impulse Threshold	Available Full-Scale Ranges
20-24 Vpk	+/-100 or 200 volts full-scale
24-49 Vpk	+/-100, 200 or 400 volts full-scale
50 Vpk	+/-100, 200, 400 or 800 volts full-scale
51-99 Vpk	+/-200, 400 or 800 volts full-scale
100 Vpk	+/-200, 400, 800 or 1600 volts full-scale
101-199 Vpk	+/-400, 800 or 1600 volts full-scale
200 Vpk	+/-400, 800, 1600 or 3200 volts full-scale
201-399 Vpk	+/-800, 1600 or 3200 volts full-scale
400 Vpk	+/-800, 1600, 3200 or 6400 volts full-scale
401-800 Vpk	+/-1600, 3200 or 6400 volts full-scale

If you selected AUTO Impulse Ranging in the Key Operator Menu (or plan to), the full-scale impulse range will be selected for you as follows:

Automatic Impulse Ranging Table

If Impulse Threshold selected in previous question is between...	The Impulse Range will set automatically to...
20 - 50 volts	+/- 100 volts
51 - 100 volts	+/- 200 volts
101 - 200 volts	+/- 400 volts
201 - 400 volts	+/- 800 volts
401 - 800 volts	+/- 1600 volts
801 - 1600 volts	+/- 3200 volts
1601- 6000 volts	+/- 6400 volts

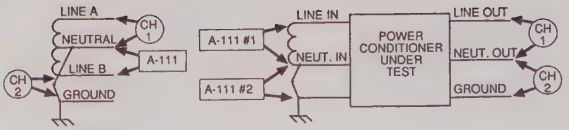
HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the full scale impulse range.
(If you want the PowerScope to choose
a range for you automatically, use the
Key Operator menu to select AUTO
impulse ranging.  The PowerScope will
automatically select a range that will
give you a good compromise between
resolution and dynamic range.)

(Press HELP! for more information on
selecting full scale ranges.)

=====================================
```

```
=====================================

The full scale impulse ranges are:

       100 Vpk
       200 Vpk
       400 Vpk
       800 Vpk
      1600 Vpk
      3200 Vpk
      6400 Vpk

To preserve resolution, the
PowerScope will not allow you to
select a full scale range that is
less than two times your impulse
threshold or greater than 16 times
your impulse threshold:

Full scale      Acceptable thresholds
----------      ---------------------
  100 Vpk          20 Vpk -    50 Vpk
  200 Vpk          20 Vpk -   100 Vpk
  400 Vpk          20 Vpk -   200 Vpk
  800 Vpk          50 Vpk -   400 Vpk
 1600 Vpk         100 Vpk -   800 Vpk
 3200 Vpk         200 Vpk -  1600 Vpk
 6400 Vpk         400 Vpk -  6000 Vpk

(Press HELP! again for general infor-
mation on the Setup Menu.)

=====================================
```

2 Dual-One Phase

2. Dual One Phase

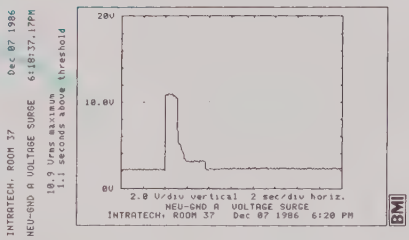


Neut-Gnd: 10.0Vrms

Range: 0.1 Vrms to 99.9 Vrms

Use the number keys to enter the voltage-surge threshold for neutral-to-ground A.

You may select any value from 0.1 Vrms to 99.9 Vrms. (Typical thresholds range between 1.0 and 10.0 Vrms.)



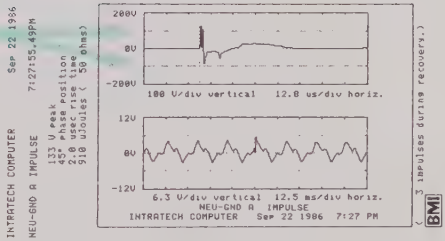
Neutral-to-ground A surge graph.

N-G Imp thr: 100Vpk

Range: 20 Vpk to 6000 Vpk

Use the number keys to enter the smallest impulse you want the PowerScope to graph on neutral-to-ground A.

Typical thresholds are between 50-250 volts. You may select any value from 20 volts to 6000 volts.



Neutral-to-ground A impulse graph.

HELP!

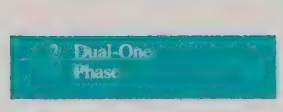
```
====================================

Use the number keys to enter the
acceptable ac voltage difference
between the neutral and ground lines
being monitored by the PowerScope.
Typical thresholds are in the range
of 1.0-10.0 Vrms.  You may select any
value from 0.1 Vrms to 99.9 Vrms.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```

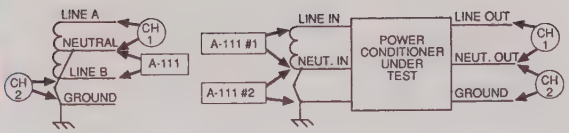
```
====================================

Use the number keys to enter the
value of the smallest neutral-ground
impulse you wish the PowerScope to
report. Typical thresholds are in the
range of 50-250 volts.  You may
select any value from 20 to 6000
volts.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```


Dual-One Phase

Three-Phase Delta

Your Comments Please





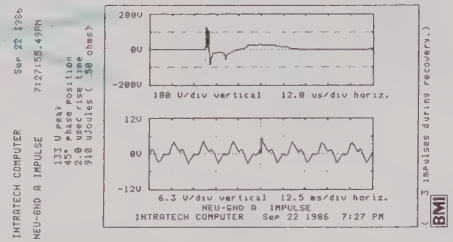
NOTE: You'll only get the next question if you have Impulse Ranging in the Key Operator Menu set to MANUAL.

N-G imp. range: 200 Vpk

Possible selections: See the following table.

The selections depend on the impulse threshold, e.g. for a 20 - 24 Vpk threshold, there are 2 full-scale ranges available, 100 or 200 volts full-scale.

Use the VALUE UP/ VALUE DOWN keys to select the full-scale impulse range for neutral-to-ground A.



Neutral-to-ground A impulse graph.

Manual Impulse Ranging Table

Impulse Threshold	Available Full-Scale Ranges
20-24 Vpk	+/-100 or 200 volts full-scale
24-49 Vpk	+/-100, 200 or 400 volts full-scale
50 Vpk	+/-100, 200, 400 or 800 volts full-scale
51-99 Vpk	+/-200, 400 or 800 volts full-scale
100 Vpk	+/-200, 400, 800 or 1600 volts full-scale
101-199 Vpk	+/-400, 800 or 1600 volts full-scale
200 Vpk	+/-400, 800, 1600 or 3200 volts full-scale
201-399 Vpk	+/-800, 1600 or 3200 volts full-scale
400 Vpk	+/-800, 1600, 3200 or 6400 volts full-scale
401-800 Vpk	+/-1600, 3200 or 6400 volts full-scale

Automatic Impulse Ranging Table

If you selected AUTO Impulse Ranging in the Key Operator Menu (or plan to), the full-scale impulse range will be selected for you as follows:

Impulse Threshold	Full-Scale Range Set Automatically to...
20 - 50 volts	+/- 100 volts
51 - 100 volts	+/- 200 volts
101 - 200 volts	+/- 400 volts
201 - 400 volts	+/- 800 volts
401 - 800 volts	+/- 1600 volts
801 - 1600 volts	+/- 3200 volts
1601- 6000 volts	+/- 6400 volts

HELP!

Use the VALUE UP/VALUE DOWN keys to select the full scale impulse range. (If you want the PowerScope to choose a range for you automatically, use the Key Operator menu to select AUTO impulse ranging. The PowerScope will automatically select a range that will give you a good compromise between resolution and dynamic range.)

(Press HELP! for more information on selecting full scale ranges.)

The full scale impulse ranges are:

100 Vpk
200 Vpk
400 Vpk
800 Vpk
1600 Vpk
3200 Vpk
6400 Vpk

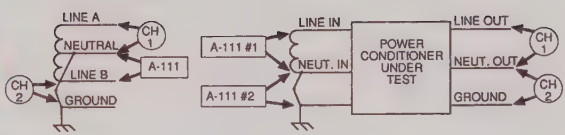
To preserve resolution, the PowerScope will not allow you to select a full scale range that is less than two times your impulse threshold or greater than 16 times your impulse threshold:

Full scale	Acceptable thresholds
100 Vpk	20 Vpk - 50 Vpk
200 Vpk	20 Vpk - 100 Vpk
400 Vpk	20 Vpk - 200 Vpk
800 Vpk	50 Vpk - 400 Vpk
1600 Vpk	100 Vpk - 800 Vpk
3200 Vpk	200 Vpk - 1600 Vpk
6400 Vpk	400 Vpk - 6000 Vpk

(Press HELP! again for general information on the Setup Menu.)

---

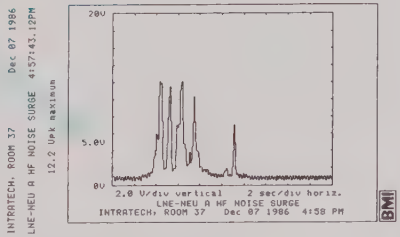
2 Dual-One Phase



Hi. freq. noise: 5.0V

Range: 1.0V to 19.9V

Use the number keys to enter the high frequency noise disturbance threshold (measured in peak volts).



High frequency noise disturbance graph.

This value value applies to all line of the dual-one phase power line you are monitoring. A typical threshold is 5.0 Vpk. The acceptable range is 1.0 Vpk to 19.9 Vpk.

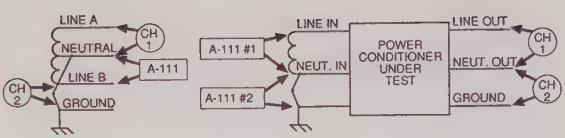
NOTE: If you are using probes for environmental monitoring there will be additional questions. See page 6-2 for a discussion of optional probes.

HELP!

```
=====================================

Use the number keys to enter the
high frequency noise disturbance
threshold (measured in peak-to-peak
volts).  A typical threshold is
5.0 Vpk.  The acceptable range is
1.0 Vpk to 19.9 Vpk.

(Press HELP! again for general infor-
mation on the Setup Menu.)

=====================================
```

2. Dual-One Phase

2: Dual One Phase



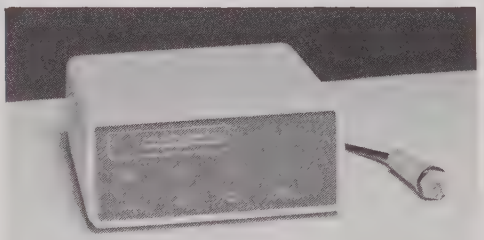
Using an A-111 AC/DC/Impulse probe for phase B

NOTE: The following questions appear if you are using a BMI A-111 AC/DC/Impulse probe to monitor phase B of dual-one phase. The A-111 must be plugged into one of the environmental sensor channels on the back of the 2400 PowerScope.

Sensor Setup: A

Selections: A through D

Use the VALUE UP/ VALUE DOWN keys to select which probe you will be setting thresholds for now.

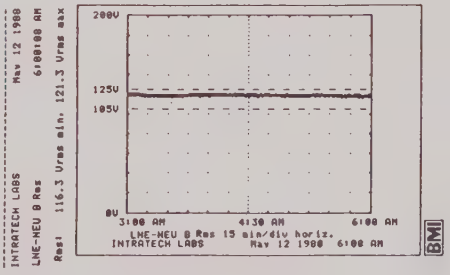


All probes plug into any of the environmental sensor channels, labeled A through D, on the back of the PowerScope. The A-111 AC/DC/Impulse probe extends the voltage measuring capability of the 2400 PowerScope by adding additional AC or DC channels. The probe measures true rms voltage for AC.

Name: LNE-NEU B

You may enter up to 9 characters to name this AC/DC/Impulse probe. Use the number keys to enter the name of this sensor.

With an A-111 probe connected, the name "LNE-NEU B" will appear. You will be monitoring Phase B of dual one-phase on this channel.



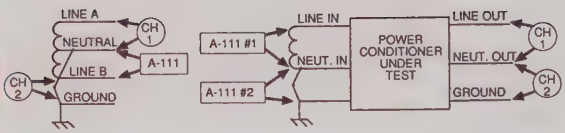
Rms summary strip chart from the A-111.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
choose which probe you will set
thresholds for now.  The choices you
have will depend on which environ-
mental channels you have probes
plugged into. The four environmental
channels are lettered A-D.

(Press HELP! again for general infor-
mation on the Setup Menu).

====================================
```

```
====================================

You may enter up to 9 characters from
the keyboard to name this AC/DC
Voltage/Impulse probe.

Use the left and right arrow keys to
move the flashing cursor.  Use the
number keys to enter both letters and
numbers.  For example, to enter the
letter 'B', push the '2ABC' key three
times.  Then move the flashing cursor
to the next character.

(There is no more HELP!)

====================================
```

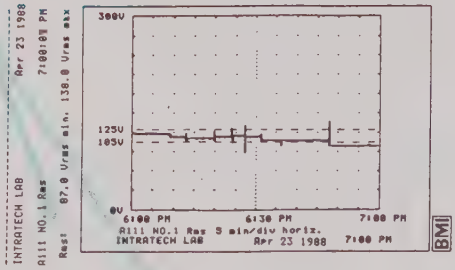
2. Dual-One Phase



Sensor Mode: Rms

Selections: Rms
Vdc

Use the VALUE UP/ VALUE DOWN keys to choose whether you will use this probe to monitor alternating or direct current.



This is a one-hour summary strip chart of rms voltage.

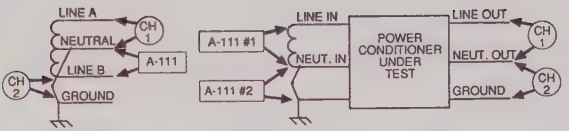
```
-----------------------------------------
INTRATECH LAB                Apr 23 1988

LNE-NEU B VOLTAGE SAG        4:45:58 PM
(Sensor A)

 Voltage below          105.0 Vrms


-----------------------------------------
INTRATECH LAB                Apr 23 1988

LNE-NEU B VOLTAGE SAG END    4:45:58 PM
(Sensor A)

 Minimum voltage:        72.0 Vrms
```

This is a text report of a disturbance.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the mode of this AC/DC/Impulse
probe.   Your choices are:

RMS  -  This should be selected for
        monitoring AC lines.
        It will make true
        RMS measurements.

VDC  -  This should be selected for
        monitoring batteries and
        DC supplies.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```

AC/DC Impulse high-voltage threshold

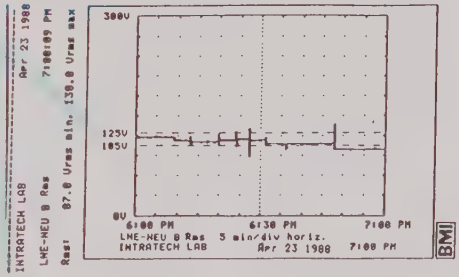


LNE-NEU B high:125.0Vrms

Selections: 1.0 to 600.0 Vrms
1 to 99.9Vdc

Use the number keys to enter the high-voltage threshold for this probe.

The acceptable range is 1.0 to 600.0 Vrms, or 1.0 to 99.9 Vdc. Usually the threshold should be set to 10% above the nominal voltage. A typical value is 125.0 Vrms, or 5.5 Vdc.



Rms 1-Hr strip chart.

```
INTRATECH LAB                    Apr 23 1988

LNE-NEU B VOLTAGE SURGE          4:44:44 PM
(Sensor A)

 Voltage above          125.0 Vrms
```

```
INTRATECH LAB                    Apr 23 1988

LNE-NEU B VOLT SURGE END         4:44:50 PM
(Sensor A)

 Maximum voltage:       132.0 Vrms
```

Rms disturbance text report.

Rms Full-scale Range Table

The full-scale range is determine by the high-voltage threshold as follows:

High-voltage threshold	Full-scale range
1.0 - 15.0 Vrms	20.0 Vrms
15.1 - 130.0 Vrms	150.0 Vrms
130.1 - 260.0 Vrms	300.0 Vrms
260.1 - 600.0 Vrms	600.0 Vrms

Vdc Full-scale Range Table

High-voltage threshold	Full-scale range
1.0 - 6.0 Vdc	10.0 Vdc
6.1 - 16.0 Vdc	20.0 Vdc
16.1 - 99.9 Vdc	100.0 Vdc

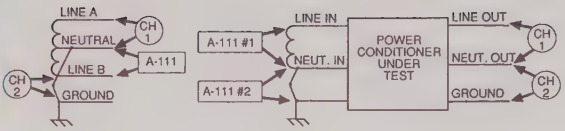
HELP!

```
=====================================

Use the number keys to enter the high
voltage threshold for this probe.  The
usual value is about 10% above the
nominal voltage.  The acceptable range
is 1.0 Vrms to 600.0 Vrms.   A typical
value is 125.0 Vrms.

(Press HELP! again for information on
how threshold settings affect the
full scale range of this probe.)

=====================================
```

```
=====================================

The high voltage threshold that
you select will also determine the
full scale setting of this probe, as
follows:

   High Voltage        Full Scale
    threshold           setting
-----------------     ----------

  1.0 -  15.0 Vrms      20.0 Vrms
 15.1 - 130.0 Vrms     150.0 Vrms
130.1 - 260.0 Vrms     300.0 Vrms
260.1 - 600.0 Vrms     600.0 Vrms

(Press HELP! again for general infor-
mation on the Setup menu.)

=====================================
```


2 Dual-Out Phase

2: Dual One Phase

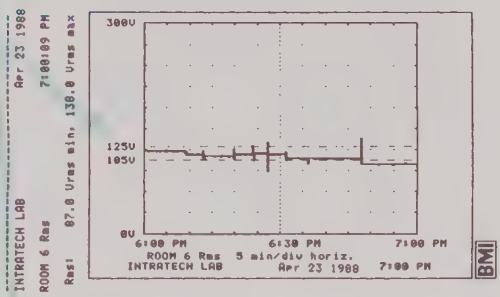


LNE-NEU B low: 105.0Vrms

Selections: 0.0 to 599.9 Vrms
0.0 to 99.8Vdc

Use the number keys to enter the low-voltage threshold for this probe.

The acceptable range is 0.0 to 599.9 Vrms, or 0.0 to 99.8 Vdc. Usually the setting should be made to 10% below the nominal voltage. A typical value is 105.0 Vrms, or 4.5 Vdc.



Rms 1-Hr strip chart.

```
INTRATECH LAB                    Apr 23 1988
LNE NEU B VOLTAGE SAG            4:45:58 PM
(Sensor B)

 Voltage below          105.0 Vrms
```

```
INTRATECH LAB                    Apr 23 1988 8
LNE NEU B VOLTAGE SAG END        4:45:58 PM
(Sensor B)

 Minimum voltage!       72.8 Vrms
```

Rms disturbance text report.

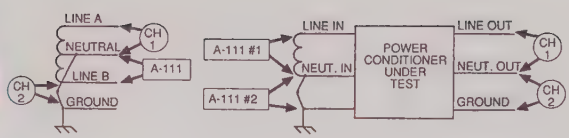
HELP!

```
====================================

Use the number keys to enter the low
voltage threshold for this sensor. The
usual value is about 10% below the
nominal voltage.  The acceptable range
is 0.0 Vrms to 599.9 Vrms.  A typical
value is 105.0 Vrms.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```


2. Dual-One Pha...

Your Comments Please

2. Dual-One Phase

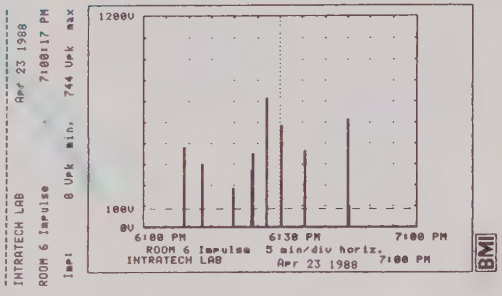


LNE-NEU B Impulse: 100Vpk

Range: 10.0 to 2400.0 Vpk AC
10.0 to 400.0 Vpk DC

Use the number keys to enter the impulse threshold.

The acceptable impulse threshold settings for this probe depend on the high-voltage threshold you set in the previous question.



Impulse 1-Hr strip chart.

```
INTRATECH LAB                    Apr 23 1988
LNE-NEU B IMPULSE                4:45:29 PM
(Sensor B)
Peak voltage:                    780 Vpk
```

Impulse text report.

The full-scale range is determine by the high-voltage threshold as follows:

Rms Full-scale Range Table

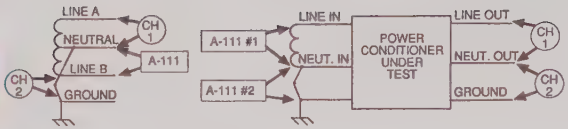
High-voltage threshold	Full-scale range
1.0 - 15.0 Vrms	20.0 Vrms
15.1 - 130.0 Vrms	150.0 Vrms
130.1 - 260.0 Vrms	300.0 Vrms
260.1 - 600.0 Vrms	600.0 Vrms

Vdc Full-scale Range Table

High-voltage threshold	Full-scale range
1.0 - 6.0 Vdc	10.0 Vdc
6.1 - 16.0 Vdc	20.0 Vdc
16.1 - 99.9 Vdc	100.0 Vdc

HELP!

```
====================================

Use the number keys to enter the
impulse threshold for this sensor. The
acceptable range of impulse thresholds
depends on the high voltage threshold
that you have selected for this probe.

(Press HELP! again for information on
how high voltage thresholds affect
impulse thresholds if monitoring DC.
Press HELP! twice for information
on how high voltage thresholds affect
impulse thresholds if monitoring AC).

====================================
```



The Report Menu lets you choose the graphs and summary reports your PowerScope prints. For a complete discussion of graphs and strip charts, see appendix A.

Quick Guide

1. Press the REPORT MENU key.

2. Use the VALUE UP/VALUE DOWN keys to answer the questions in the menu.

3. Press the down arrow to go to the next question.

4. Press the HELP! key if you want further explanation about the questions.

Press the REPORT MENU key now.

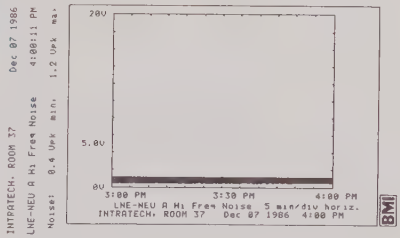
If you get the following message in the display, it's because the PowerScope has strip charts from the previous monitoring period.

Summary rpts: Print

Possible selections: Print
Clear

Press the VALUE UP/ VALUE DOWN keys to choose whether you want the pending strip charts.

If you want them printed then erased, position PRINT in the display, then press the down arrow.
If you want them erased immediately, position CLEAR in the display, then press the down arrow.



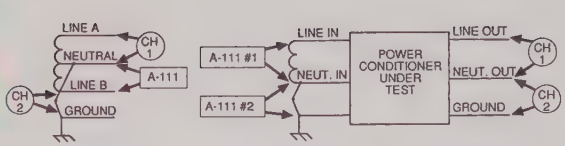
This is a summary strip chart.

Then, press the REPORT MENU key again and proceed.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select PRINT or CLEAR and then
use the DOWN ARROW key to enter
the menu you have selected.

If you select PRINT, the summary data
and strip charts that have been
gathered so far by the PowerScope will
be printed and then reset. If you
select CLEAR, all of the summary
data and strip charts will be reset
without printing.

If you don't want to lose any summary
data, you may return to the Monitor
mode by pressing the MONITOR key.

(There is no more HELP!)

====================================
```

2. Dual-One Phase



Threshold report: On

Selections: On
Off

Use the VALUE UP/ VALUE DOWN keys to turn the Threshold Report on or off.

Your PowerScope prints the Threshold Report after you press the MONITOR key. The Threshold Report shows all the current settings. Generally, you should leave this report on.

If you don't want to see it as it begins printing, press the CANCEL PRINTER key.

If you don't want to see either the Threshold Report or the initial waveshape graphs, quickly press the up arrow key after pressing the MONITOR key and these reports will both be cancelled.

```
=====================================

BNI 2400 SITE                Jan 01 1988

THRESHOLD REPORT                12:37 AM

Type:      Dual 1-phase

LNE-NEU A THRESHOLDS (Channel 1)
      Surge voltage:  125.0 Vrms
      Sag voltage:    105.0 Vrms
      Impulse:          200 Vpk
      High freq noise: 10.0 Vpk
      High frequency:  61.2 Hz
      Low  frequency:  58.8 Hz
      Wave shape:       20% variation
      Minimum duration: 0.1 cycles
      Line impedance:    50 ohms
      Hysteresis:      1.0%

NEU-GND A THRESHOLDS (Channel 2)
      Surge voltage:    5.0 Vrms
      Impulse:          100 Vpk
      High freq noise: 10.0 Vpk
      Line impedance:    50 ohms
      Hysteresis:      1.0%

LNE-NEU B THRESHOLDS (Sensor A)
      Surge voltage:  125.0 Vrms
      Sag voltage:    105.0 Vrms
      Impulse:          100 Vpk

SUMMARY REPORT INTERVAL:  Off

Internal UPS time:  5 minutes.



Initial waveshape graphs turned off.
```

Threshold report.

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to turn the Threshold Report on or off. This report should normally be left on.

(Press HELP! again for more information on Threshold Reports).

==========

==========

The Threshold Report is the list of thresholds and settings your PowerScope can print automatically before it begins monitoring.

(If you turn the Threshold Report on now, you can still omit it when you begin monitoring by pressing the MONITOR key followed immediately by the UP ARROW key.)

(Press HELP! again for general information on the Report Menu).

==========

==========

The Report Menu contains questions that define the type of summary strip charts you would like, and over what time duration you would like them.

The questions in the Report Menu vary depending on the type of power each channel is monitoring, and if you have probes plugged into the environmental channels.

(Press HELP! again for general information on the operating sequence.)

==========

==========

The usual sequence for operating the PowerScope monitor is:

1) Press the SETUP MENU key and answer the questions. To go on to the next question, press the Down Arrow.

2) Connect the monitor to the power line. (See the HELP! message in the Setup Menu for the 'TYPE:' question.)

3) Press the MONITOR key to monitor the power line. Your reports will be printed automatically.

(Press HELP! again for general information on the six modes of operation.)

==========

==========

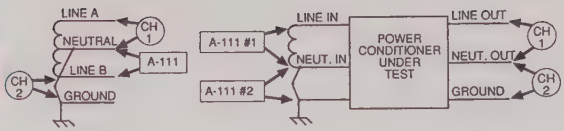
The PowerScope monitor can be in one of six modes:

1) Press the SETUP MENU key to program the Setup Menu. Use the up arrow and the down arrow key to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu. (You may want to press 'HELP!' when you have selected the type of power line you are going to monitor. This will give you installation instructions.)

   By pressing the SETUP MENU key, then immediately pressing the UP ARROW key, you will enter the Key Operator Menu. This menu will give you control of the detailed operation of the PowerScope.

(Continued page 2-37)

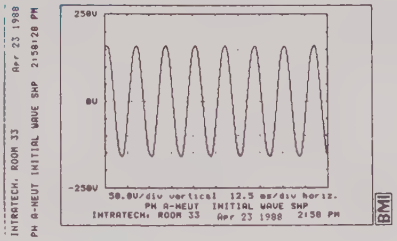
2: Dual-One Phase



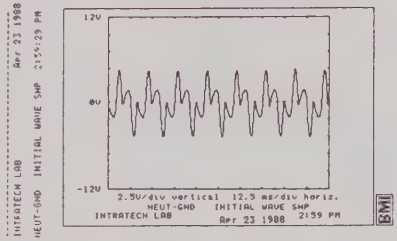
Initial waves: On

Selections: On
Off

Use the VALUE UP/ VALUE DOWN keys to turn the initial waveshape graphs on or off.



Your PowerScope prints initial waveshape graphs after the Threshold Report . These graphs show the initial condition of the sine waves. Generally, you should leave this report on.



Initial waveshape reports for phase A to neurtal and neutral-to-ground.

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to turn the Initial Waveshape Report on or off. This report should normally be left on.

(Press HELP! again for more information on the Initial Waveshape Report).

==========

==========

The Initial Waveshape Report shows the condition of the sine waves at the beginning of the monitoring session. Initial waveshapes may give you additional information on the condition of the power lines.

(Press HELP! again for general information on the Report Menu).

==========

(Continued from page 2-35)

2) Press the STATUS key to print the Status Report. This report tells you the present voltage, frequency, and noise on each of the channels. This report can be especially useful when you're trying to set the thresholds correctly. It's also useful for checking to see if you've installed the monitor correctly.

3) Press the REPORT MENU key to enter the Report menu. Use the up arrow and the down arrow to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu.

4) Press the MONITOR key to start monitoring the power line. The PowerScope will print a complete copy of your setup, and show you the initial waveshapes on each channel (if you have requested them in the Report Menu). Then it will print a disturbance report every time a power disturbance occurs.

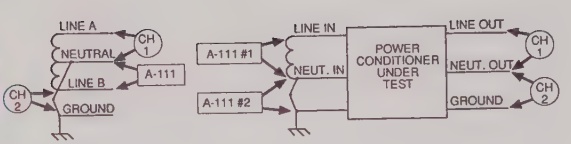
5) Press the CALIBRATION key to calibrate your PowerScope. To calibrate your PowerScope, you must connect an external A-016 Precision Calibrator to the PowerScope; If you haven't connected one, the PowerScope will print its most recent calibration data.

6) Press the SELF TEST key to test the PowerScope.

(There is no more HELP!)

==========

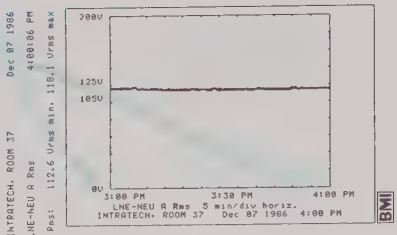
Dual-One Phase



Strip charts: 1 Hr

Selections: 24 Hr
12 Hr
6 Hr
3 Hr
1 Hr

Use the VALUE UP/ VALUE DOWN keys to set the strip chart interval.



This is a 1-Hr strip chart.

```
----------------------------------------
INTRATECH LABS                Jan 03 1989

STRIP CHART REPORT                 6:00 PM
 From  5:00 PM  To  6:00 PM

LINE-NEU A (Channel 1)
 Rms:   119.8 Vrms min, 124.7 Vrms max
 Noise:   0.0 Vpk  min,   1.0 Vpk  max
 Freq:   60.0 Hz   min,  60.0 Hz   max
 Imp:       0 counted

NEUT-GND   (Channel 2)
 Rms:     0.6 Vrms min,   1.9 Vrms max
 Noise:   0.3 Vpk  min,   0.9 Vpk  max
 Imp:       0 counted

'B NEUT   (Sensor A)
 Rms: 119.8 Vrms min, 124.7 Vrms max
 Imp:              17 Vpk  max
```

This is a summary strip chart report.

If you choose:

24 hr – strip charts will be printed every 24 hours at midnight.
12 hr – strip charts will be printed every 12 hours beginning at 12:00.
6 hr – strip charts will be printed every 6 hours beginning at 6:00.
3 hr – strip charts will be printed every 3 hours beginning at 3:00.
1 hr – strip charts will be printed every hour on the hour.
Off–no long-term summary information will be printed.

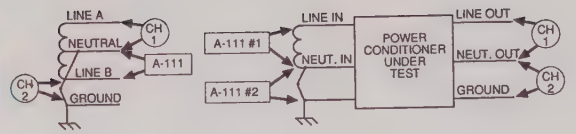
NOTE: Whatever strip chart interval you choose here will appear in the forthcoming questions.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the time interval between
printing strip charts and summary
reports.

Possible selections are: 24 hours,
12 hours, 6 hours, 3 hours, 1 hour,
or OFF.  The interval that you choose
impacts the choices offered you in the
next series of questions.

(Press HELP! for more information on
selecting strip chart summary
reports).

=====================================

=====================================

If you choose, for example, 12-hour
strip chart summaries, your choices
in the next questions regarding
individual strip chart summary reports
will include 12-hour strip charts.
(If you choose 3-hour strip charts
here, your choices in the next
questions will include 3-hour strip
charts, and so on.)

(Press HELP! for general information
on the Setup Menu.)

=====================================
```


2. Dual-One Phase

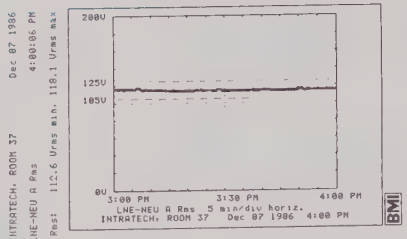
2. Dual-One Phase



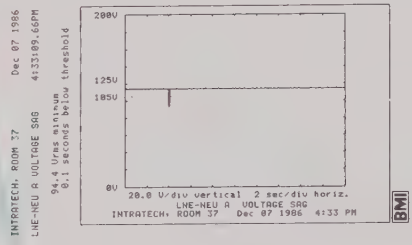
LINE-NEUT A Rms: Both

Selections: Both
1 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the line-to-neutral A Rms signal.



1-Hr strip chart: line-to-neutral A Rms.



Graph: line-to-neutral A Rms disturbance.

If you choose:

Both - your PowerScope will print both strip charts and graphs.

1-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

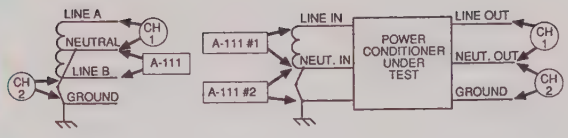
Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

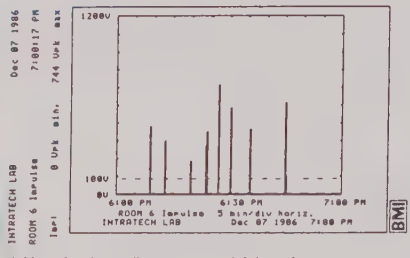
2. Dual-One Phase



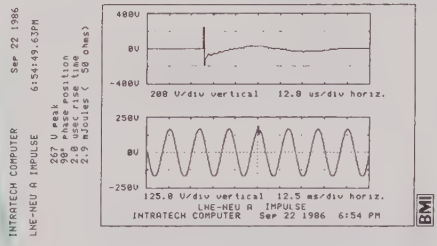
LINE-NEUT A Imp: Both

Selections: Both
1 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for line-to-neutral A impulses.



1-Hr strip chart: line-to-neutral A impulse.



Graph: line-to-neutral A impulse.

If you choose:

Both - your PowerScope will print both strip charts and disturbance graphs.

1-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

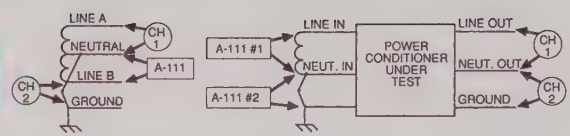
Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Off - no disturbance graphs or strip charts will be printed for this signal, however the maximum reading of this signal will be reported textually in the summary reports.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

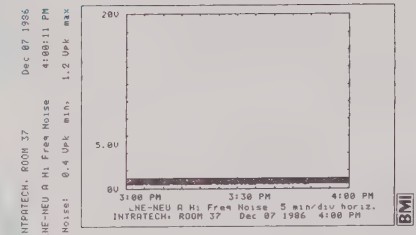
2. Dual-One Phase



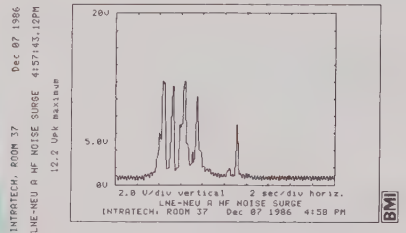
LINE-NEUT A HFN: Both

Selections: Both
1 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the high-frequency noise disturbances on line-to-neutral A.



1-Hr strip chart: line-to-neutral A high-frequency noise.



Graph: line-to-neutral A high-frequency noise.

If you choose:

Both - your PowerScope will print both strip charts and graphs.

1-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

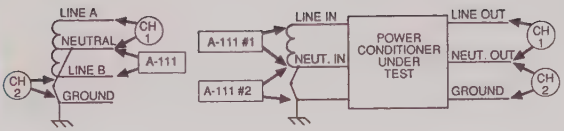
Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

=====================================
```

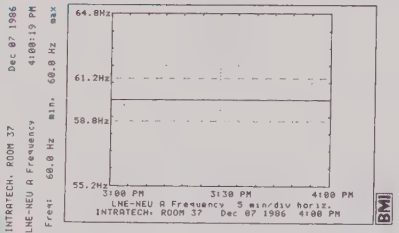
2. Dual-One Phase



LINE-NEUT A Freq: Both

Selections: Both
1 Hr
Text
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the line-to-neutral A frequency signal.



1-Hr strip chart: line-to-neutral A frequency.

```
INTRATECH, ROOM 37          Dec 07 1986
LNE-NEU A LOW FREQ.      5:07:49.73PM
     Frequency below:        59.4 Hz

----------------------------------------
INTRATECH, ROOM 37          Dec 07 1986
LNE-NEU A LOW FREQ END   5:07:53.88PM
     Minimum frequency:      59.0Hz
```

Text report: line-to-neutral A frequency disturbance.

If you choose:

Both - your PowerScope will print both strip charts and text disturbance reports.

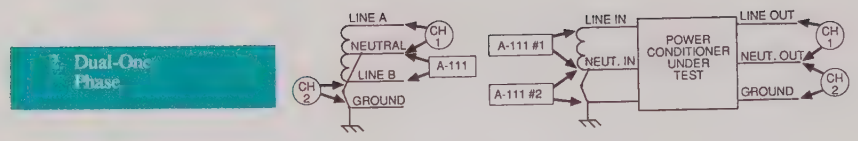
1-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print text disturbance reports.

Text - your PowerScope will print text disturbance reports of this signal, but won't print strip charts.

Off - no text disturbance reports or strip charts will be printed for this signal, however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a textual
     disturbance reports of this
     signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance reports.

TEXT -
     Your PowerScope will print a
     textual report of all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither textual reports nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu,
you will not have the choice of
strip chart summaries in this
question.

(Press HELP! again for general infor-
mation on the Report Menu.)

=====================================
```

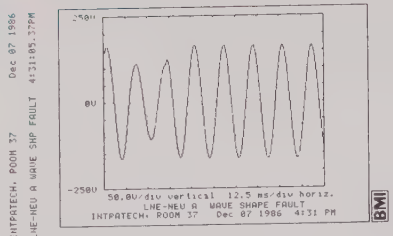


LINE-NEUT A Wave: On

Selections: On
Off

Use the VALUE UP/ VALUE DOWN keys to turn line-to-neutral A waveshape fault graphs on or off.

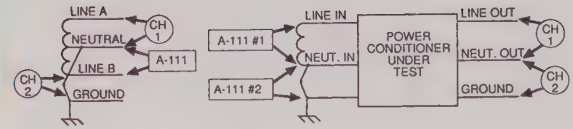
Generally, these graphs should be left on.



Line-to-neutral A waveshape fault graph.

HELP!

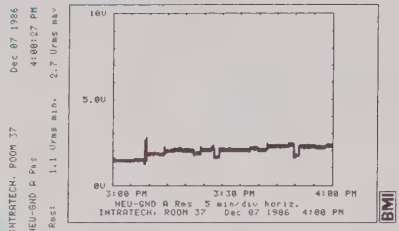
```
====================================

Use the VALUE UP/VALUE DOWN keys to
turn on or off the Waveshape fault
disturbance reporting for this signal.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```



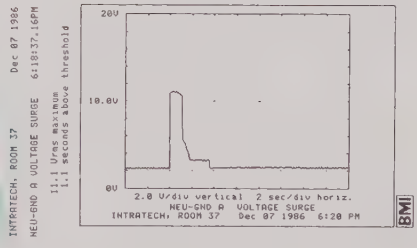
NEUT-GND A Rms: Both

Selections:Both
1 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the neutral-to-ground A Rms signal.



1-Hr strip chart: neutral-to-ground A Rms.



Graph: neutral-to-ground A surge.

If you choose:

Both - your PowerScope will print both strip charts and disturbance graphs.

1-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

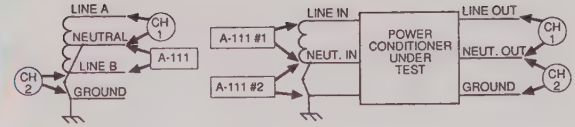
Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Off - no text disturbance reports or strip charts will be printed for this signal, however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

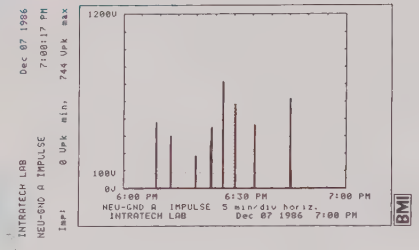

1. Single-phase
2. Dual-One Phase
3. Three-Phase Delta
4. Three-Phase Wye
5. DC or Custom Setups
6. Probes and Accessories
7. If you have a Delta
8. Key Questions
9. Connections
10. Operation
11. Loading Paper
12. Troubleshooting
13. Specifications
A. Graphs
B. Recommended Extensions
Index
Your Comments Please



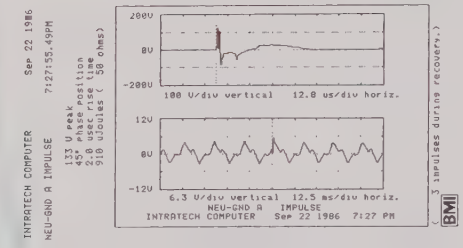
NEUT-GND A Imp: Both

Selections: Both
1 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to turn neutral-to-ground A impulse graphs on or off.



1-Hr strip chart: neutral-to-ground A impulse.



Graph: neutral-to-ground A impulse.

If you choose:

Both - your PowerScope will print both strip charts and disturbance graphs.

1-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Off - no disturbance graphs or strip charts will be printed for this signal, however the maximum reading of this signal will be reported textually in the summary reports.

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to select the report(s) you'd like for this signal.

You have four choices:

Both -
Your PowerScope will print both a strip chart summary and a disturbance graph of this signal.

Strip Chart Interval -
You will get only a strip chart summary of this signal, without disturbance graphs.

GRAPH -
Your PowerScope will graph all disturbances for this signal but will not print a strip chart for this signal.

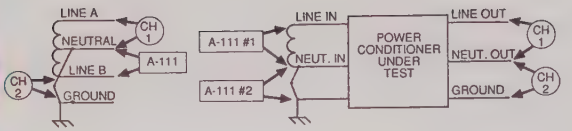
OFF -
Your PowerScope will print neither disturbance graphs nor a strip chart, but the minimum and maximum readings of this signal will still be printed in the summary reports.

If you turned strip charts off at the beginning of the Report Menu, you will not have the choice of a strip chart summary in this question.

(Press HELP! again for general information on the Report Menu.)

==========

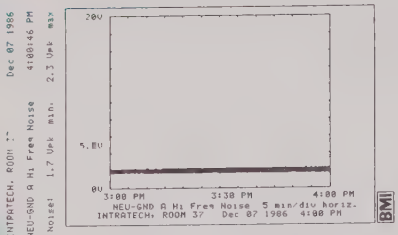
2 Dual-One Phase



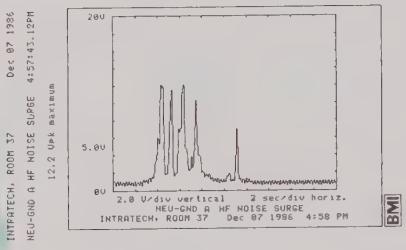
NEUT-GND A HFN: Both

Selections: Both
1 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the neutral-to-ground A high-frequency noise signal.



1-Hr strip chart: neutral-to-ground A high-frequency noise.



Graph: neutral-to-ground A high-frequency noise disturbance.

If you choose:

Both - your PowerScope will print both strip charts and disturbance graphs.

1-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

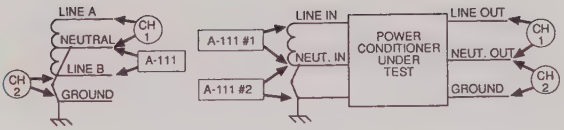
Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Off - no text disturbance reports or strip charts will be printed for this signal, however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

=====================================
```

2. Dual-One Phase



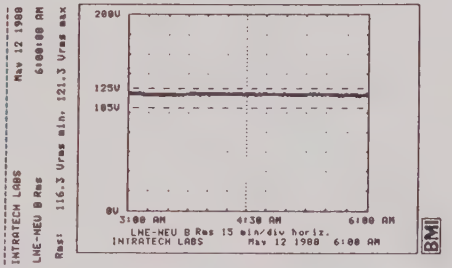
Using an A-111 AC/DC Impulse probe for phase B

NOTE: The following questions appear if you are using a BMI A-111 AC/DC/Impulse probe to monitor phase B of dual-one phase. The A-111 must be plugged into one of the "environmental" channels on the back of the 2400 PowerScope.

LNE-NEU B Rms: Both

Selections: Both
3 Hr
Text
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the voltage signal of the AC/DC/ Impulse probe.



3-Hr strip chart: Rms.

```
-----------------------------------------
INTRATECH LAB                Apr 23 1988

LNE-NEU B VOLTAGE SURGE      4:44:44 PM
(Sensor A)

 Voltage above          125.0 Vrms


-----------------------------------------
INTRATECH LAB                Apr 23 1988

LNE-NEU B VOLT SURGE END     4:44:50 PM
(Sensor A)

 Maximum voltage:       132.0 Vrms
```

Text report: Rms.

If you choose:

Both - your PowerScope will print both strip charts and text reports.

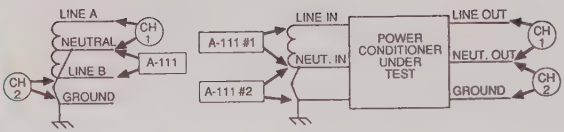
3-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance text reports of this signal.

Text - your PowerScope will print disturbance text reports of this signal, but won't print strip charts.

Off - no disturbance text reports or strip charts will be printed for this signal; however the maximum reading of this signal will be reported textually in the summary reports.

HELP!

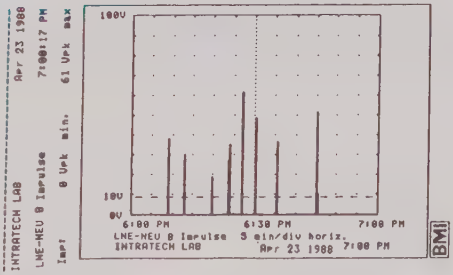
```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a textual
     disturbance reports of this
     signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance reports.

TEXT -
     Your PowerScope will print a
     textual report of all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither textual reports nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu,
you will not have the choice of
strip chart summaries in this
question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```



LNE-NEU B Imp: Both

Selections: Both
1-Hr
Text
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for Line-to-Neutral B impulses.



1-Hr strip chart: Impulse signal from AC/DC/Impulse probe.

```
INTRATECH LAB                    Apr 23 1988

LNE-NEU B IMPULSE                4:45:29 PM
(Sensor B)

 Peak voltage:                   780 Vpk
```

Text report: Impulse.

If you choose:

Both - your PowerScope will print both strip charts and text reports.

1-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance text reports of this signal.

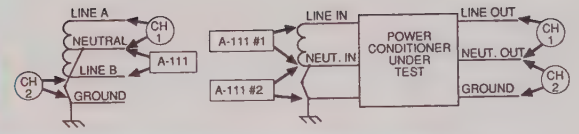
Text - your PowerScope will print disturbance text reports of this signal, but won't print strip charts.

Off - no disturbance text reports or strip charts will be printed for this signal; however the maximum reading of this signal will be reported textually in the summary reports.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a textual
     disturbance reports of this
     signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance reports.

TEXT -
     Your PowerScope will print a
     textual report of all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither textual reports nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu,
you will not have the choice of
strip chart summaries in this
question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

2. Dual-One Phase



WARNING
You are working with high voltages that cause burns and lethal shocks. Connect the safety earth ground first. USE STANDARD SAFETY PRECAUTIONS.

Using an A-111 AC/DC/Impulse probe for phase B

Use a BMI A-111 AC/DC/Impulse Probe for a Third Channel

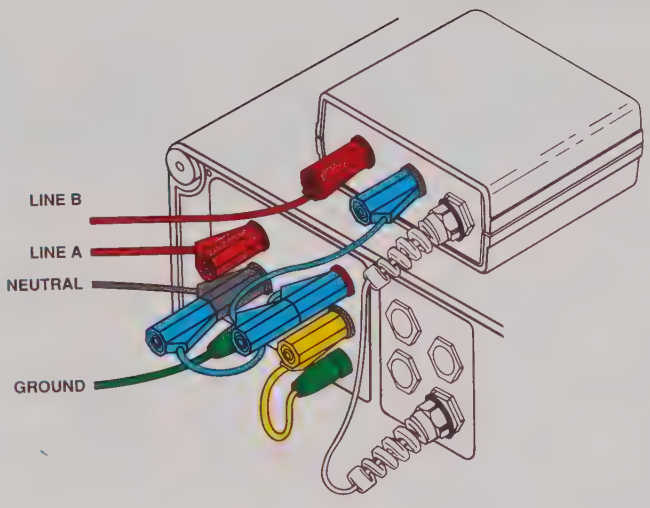
To monitor all lines of dual one-phase power (line A-to-netural, line B-to-neutral, and neutral-to-ground) requires three channels. Two of these channels are in the 2400; you will need a BMI A-111 AC/DC/Impulse probe to provide the third channel.

Our recommendation is to use the two high-resolution channels on the 2400 PowerScope to monitor line A-to-neutral, and neutral-to-ground; then, use the A-111 AC/DC/Impulse Probe to monitor line B-to-neutral. This is the configuration described below. It enables the PowerScope to capture all types of transients. For instance, phase-to-phase errors will show up on Channel 1, and any impulse on line B-to-neutral will have a high-resolution counterpart on the neutral-to-ground connection, Channel 2.

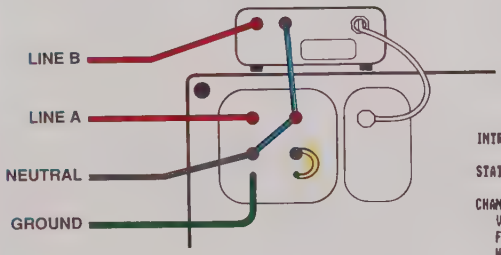
Connecting to Dual One-Phase Power (split phase)

1. **Using a green cable with green connector, connect ground into any one of the ground sockets. (The diagram shows ground plugged into the Channel 1 ground socket.)**
2. **Using a red cable, connect line A to Channel 1 red (positive).**
3. **Using a black cable, connect neutral first to a blue jumper cable, then into Channel 1 black (negative).**
4. **Connect the other end of the blue jumper into Channel 2 red (positive).**
5. **Using a yellow jumper cable, connect Channel 2 black (negative) and Channel 2 green (ground).**
6. **Using a red cable, connect Line B to the AC/DC/Impulse Probe red terminal (positive).**
7. **Using a blue jumper cable, connect Channel 2 red (positive) to the AC/DC/Impulse probe, the black terminal (negative).**

HELP!



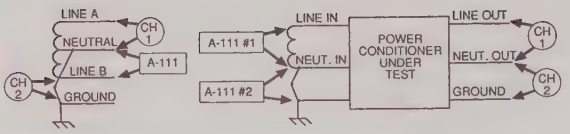
Connections for dual-one phase.



Press the STATUS key to get a printout verifying that your initial readings are within the thresholds that you've set.

```
INTRATECH LABS                  Oct 05 1988

STATUS REPORT                      11:46 AM

CHANNEL 1 (Channel 1)
   Voltage:        120.7 - 122.2 Vrms
   Frequency:       60.0 -  60.0 Hz
   Hi freq noise:    0.2 -   1.0 Vpk


NEUT-GND (Channel 2)
   Voltage:          0.1 -   0.1 Vrms
   Hi freq noise:    0.6 -   0.9 Vpk


VOLTAGE B (Sensor B)
   Voltage:        119.4 - 119.8 Vrms
   Impulse:            1 -   142 Vpk

BATTERY CONDITION
   Voltage:      10.9 Vdc
   State:        Charged
```

Press the MONITOR key to begin monitoring.



WARNING
You are working with high voltages that cause burns and lethal shocks. Connect the safety earth ground first. USE STANDARD SAFETY PRECAUTIONS.

Using two A-111 AC/DC/Impulse probes for power conditioner monitoring

Use two BMI A-111 AC/DC/Impulse Probes to monitor a Power Conditioner.

To monitor all lines of a power conditioning device requires four channels. Two of these channels are in the 2400; you will need two BMI A-111 AC/DC/Impulse probes to provide the third and fourth channels.

Our recommendation is to use the two high-resolution channels on the 2400 PowerScope to monitor the input (line-to-neutral, and neutral-to-ground input); then, use the two A-111 AC/DC/Impulse Probes to monitor the output (line-to-neutral and neutral-to-ground output). This is the configuration described below. It enables the PowerScope to capture all types of transients on the input lines, while the A-111s can capture any transients that get through the power conditioner.

Connecting to a Power Conditioner

1. **Using a single-phase measuring cable plugged into a wall outlet, connect its green ground plug into the PowerScope's Channel 1 ground.**

2. **Connect the measuring cable's red connector into an A-111 positive (red) connector.**

3. **Connect the measuring cable's black connector first into a blue jumper cable, then into the A-111's black (negative) socket. Connect the gray cable from the A-111 to the PowerScope's Environmental channel (Channel A in drawing.)**

4. **Connect the other end of the blue jumper cable into the red (positive) socket of a second A-111. Connect the gray cable from the second A-111 to the PowerScopes Environmental channel (Channel C in drawing.)**

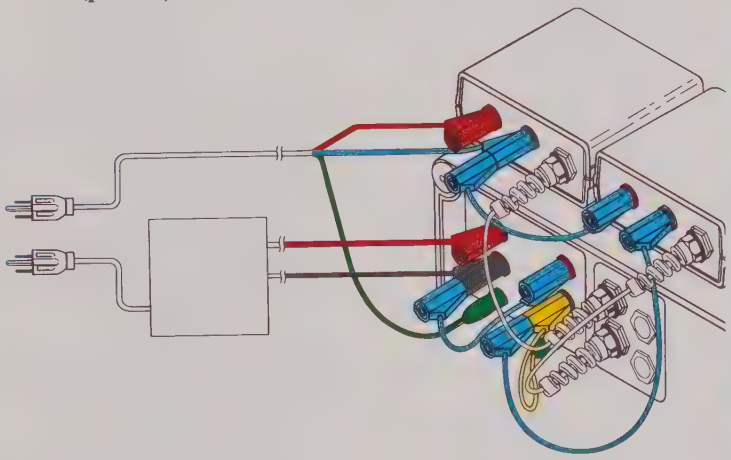
5. **Connect a yellow jumper cable with green ground plug from Channel 2 ground to a blue jumper cable, then to Channel 2 black (negative). Connect the other end of the blue jumper cable into the second A-111's black (negative) socket.**

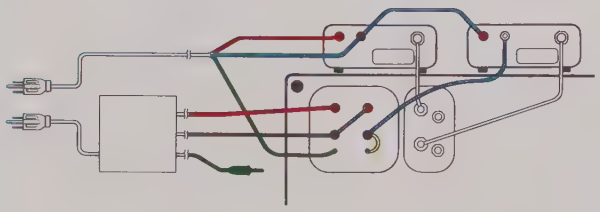
6. **Connect a red cable from the power conditioner's line out to the PowerScope's channel 1 red (positive) socket.**

7. Connect a black cable from the power conditioner's neutral first to a blue jumper cable, then into the PowerScope's Channel 1 black (negative) socket. Connect the other end of the blue jumper into the PowerScope's Channel 2 red (positive) socket.

8. Using a black cable, connect Neutral-Out first to a blue jumper cable, then into Channel 1 black (negative).

9. Connect the other end of the blue jumper into Channel 2 red (positive).

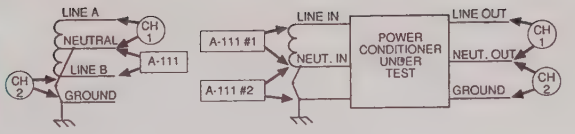




Press the STATUS key to get a printout verifying that your initial readings are within the thresholds that you've set.

Press the MONITOR key to begin monitoring.

2: Dual One Phase



DUAL 1-PHASE:

Summary of Setup menu and Report menus. Menu prompts appear in the order shown and are changed by pressing the Up Arrow or the Down Arrow. The indented options are chosen by pressing the VALUE UP/VALUE DOWN keys, and the range values (in parenthesis) are entered using the keypad.

Summary Reports: Print
Clear

Site: BMI 2400 SITE
(Any 15 character name)

Type: Single phase
-> Dual 1-phase
3-phase delta
3-phase wye
Ind. Channels

Nom. Freq.: 60.0Hz
(45-440)

Freq. Tol.: 1.2Hz
(0.2-50%)

Surge Volt: 125Vrms
(1.0-750.0Vrms)

Sag Volt: 105.0Vrms
(0.0-749.0Vrms)

Impulse thr: 200Vpk
(20Vpk-6000Vpk)

[Imp. range: 400Vpk]*
(±100-6400Vpk)

Neut-Gnd: 5.0Vrms
(0.1-99.9Vrms)

N-G Imp thr: 100Vpk
(20-6000Vpk)

[N-G Imp range: 200Vpk]*
(±100-6400Vpk)

* Appears only if Impulse ranging set to MANUAL in the Key Operator Menu

Hi-freq.noise: 10.0V
(1.0-19.9V)

The following questions appear if you are using a BMI A-111 AC/DC/Impulse probe.

Sensor Setup: A
(A, B, C, D)

Name: NEU-GND B
(Any 15 characters)

Sensor Mode: Rms
(Rms, Vdc)

NEU-GND hi: 125.0Vrms
(1.0 to 600.0 Vrms or 1 to 99.9 Vdc)

NEU-GND lo: 105.0Vrms
(0 to 599.9 Vrms or 0 to 99.8 Vdc)

NEU-GND B Imp. 100 Vpk
(10 to 2400 Vpk or 10 to 400 Vpk DC)

End of setup menu

Summary Reports: Print
Clear

Threshold report: On
Off

Initial Waves: On
Off

Strip charts: 24Hr
12Hr
6Hr
3Hr
1Hr
Off

LNE-NEU A Rms: Both
Strip chart interval
Graph
Off

LNE-NEU A Imp: Both
Strip chart interval
Graph
Off

LNE-NEU A HFN: Both
Strip chart interval
Graph
Off

LNE-NEU A Freq.: Both
Strip chart inteval
Text
Off

LNE-NEU A Wave: On
Off

NEU-GND A Rms: Both
Strip chart interval
Graph
Off

NEU-GND A Imp: Both
Strip chart interval
Graph
Off

NEU-GND A HFN: Both
Strip chart interval
Graph
Off

The following questions appear if you are using a BMI A-111 AC/DC/Impulse probe.

NEU-GND B Rms: Both
Strip chart interval*
Text
Off

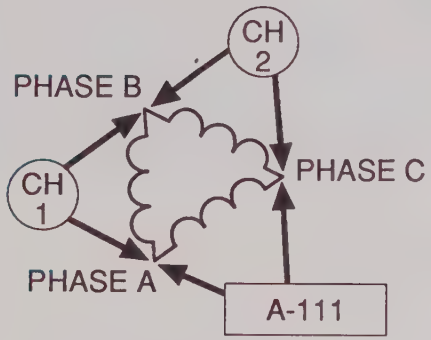
NEU-GND B Imp.: Both
Strip chart interval*
Text
Off

End of report menu

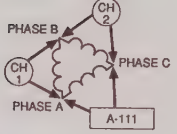
* Strip chart intervals may be selected at 1, 3, 6, 12 or 24 hours.

Chapter 3

Three-Phase Delta



3. Three-Phase Delta



This chapter shows you how to set up the PowerScope for monitoring three-phase delta.

Quick Guide

1. Press the SETUP MENU key.

2. Answer the questions in the menu using the VALUE UP/VALUE DOWN keys.

3. Press the down arrow key to go onto the next question.

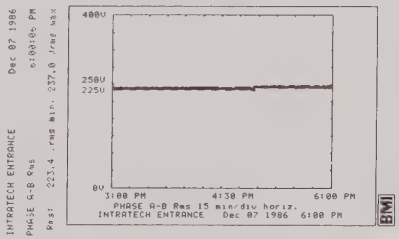
4. Press the HELP! key if you want further explanation about the question or on what to do next.

Press the SETUP MENU key now.

If you get the following message in the display, it's because the PowerScope has strip charts from the previous monitoring period.

Possible selections: Print
Clear

Use the VALUE UP/ VALUE DOWN keys to choose whether you want the pending strip charts.



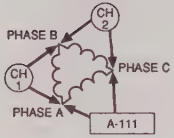
This is a summary strip chart.

If you want them printed then erased, position PRINT in the display, then press the down arrow. If you want them erased immediately, position CLEAR in the display, then press the down arrow.

Then, press the SETUP MENU key again and proceed.

HELP!

```
======================================

Use the VALUE UP/VALUE DOWN keys to
select PRINT or CLEAR and then
use the DOWN ARROW key to enter
the menu you have selected.

If you select PRINT, the summary data
and strip charts that have been
gathered so far by the PowerScope will
be printed and then reset. If you
select CLEAR, all of the summary
data and strip charts will be reset
without printing.

If you don't want to lose any summary
data, you may return to the Monitor
mode by pressing the MONITOR key.

(There is no more HELP!)

======================================
```

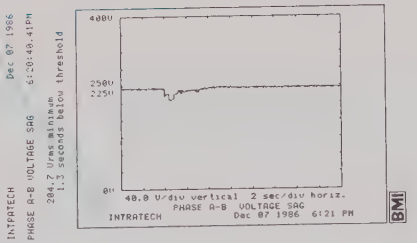


Site: INTRATECH

Use the number keys to enter the site you are monitoring.

The name can be up to 20 characters long.

Use the left arrow and right arrow keys to move the flashing cursor.



Use the number keys to enter both letters and numbers; for example, to enter the letter "K", press the 5JKL key 3 times. On the first press, a 5 will appear; on the second, a J will appear, and on the third, a K will appear.

Now move the flashing cursor to the next position by pressing the right arrow key. Press the 0 SPACE button twice to enter a space. Press the down arrow key to go on to the next question.

HELP!

You may enter up to 20 characters from the keyboard to identify the site that you are monitoring.

Use the left and right arrow keys to move the flashing cursor.

Use the number keys to enter both letters and numbers. For example, to enter the letter 'B', push the '2ABC' key three times.

(Press HELP! again for general information on the Setup Menu.)

The Setup Menu contains questions that define the operating parameters of your PowerScope. Specifically, it asks you to name the monitoring site, state what type of power each channel will monitor, and specify thresholds for each measurement.

The questions in the Setup Menu change automatically depending on what type of power you assign each channel and if you have probes plugged into the environmental channels.

(Press HELP! again for general information on the operating sequence.)

The usual sequence for operating the PowerScope monitor is:

1) Press the SETUP MENU key and answer the questions. To go on to the next question, press the Down Arrow.

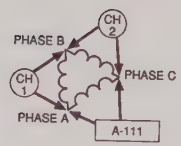
2) Connect the monitor to the power line. (See the HELP! message in the Setup Menu for the 'TYPE:' question.)

3) Press the MONITOR key to monitor the power line. Your reports will be printed automatically.

(Press HELP! again for general information on the six modes of operation.)

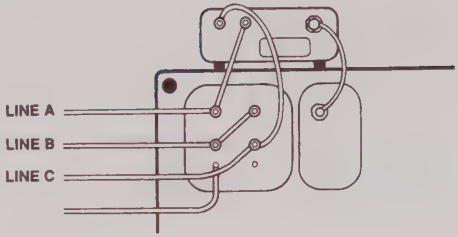
---

3. Three-Phase Delta



Type: 3-phase delta

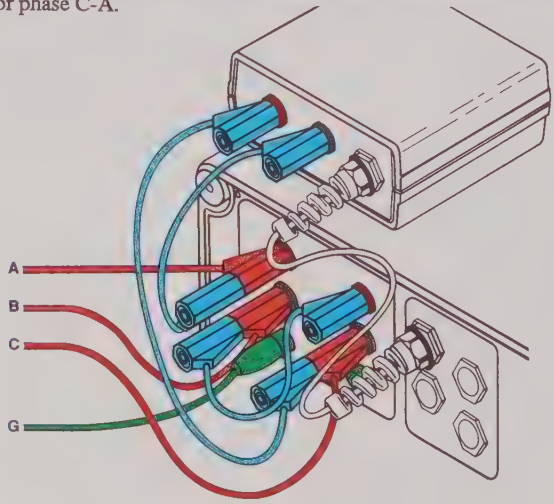
Selections: Single phase
Dual 1-phase
3-phase delta
3-phase wye
Ind. channels



Use the VALUE UP/ VALUE DOWN keys to select 3-Phase Delta.

You will need a BMI A-111 AC/DC/Impulse Probe to monitor phase C-A.

Three-phase delta connection. One BMI A-111 AC/DC/Impulse Probe is required with the PowerScope.



Press the HELP! key for information on connecting your PowerScope to Three-Phase Delta power, or see Part 3 of this chapter on page 3-50.

WARNING
You are working with high voltages that cause burns and lethal shocks. Connect the safety earth ground first. USE STANDARD SAFETY PRECAUTIONS.

HELP!

==========

Select '3 phase delta' to monitor a 3-wire, 3-phase system commonly found in industrial sites.

You will need one A-111 AC/DC/Impulse probe, connected to Environmental Sensor input 'A'.

To install the PowerScope on a 3-phase delta line, make the following connections:

```
Channel 1 GREEN terminal: SAFETY
                          GROUND

Channel 1 Red terminal:   Phase A
Channel 1 Black terminal: Phase B

Channel 2 Red terminal:   Phase B
Channel 2 Black terminal: Phase C

Environmental Sensor A:
A-111 Red terminal:       Phase C
A-111 Black terminal:     Phase A
```

(Press HELP! again for general information on the Setup Menu.)

==========

The PowerScope monitor can be in one of six modes:

1) Press the SETUP MENU key to program the Setup Menu. Use the up arrow and the down arrow key to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu. (You may want to press 'HELP!' when you have selected the type of power line you are going to monitor. This will give you installation instructions.)

   By pressing the SETUP MENU key, then immediately pressing the UP ARROW key, you will enter the Key Operator Menu. This menu will give you control of the detailed operation of the PowerScope.

2) Press the STATUS key to print the Status Report. This report tells you the present voltage, frequency, and noise on each of the channels. This report can be especially useful when you're trying to set the thresholds correctly. It's also useful for checking to see if you've installed the monitor correctly.

3) Press the REPORT MENU key to enter the Report menu. Use the up arrow and the down arrow to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu.

4) Press the MONITOR key to start monitoring the power line. The PowerScope will print a complete copy of your setup, and show you the initial waveshapes on each channel (if you have requested them in the Report Menu). Then it will print a disturbance report every time a power disturbance occurs.

5) Press the CALIBRATION key to calibrate your PowerScope. To calibrate your PowerScope, you must connect an external A-016 Precision Calibrator to the PowerScope; If you haven't connected one, the PowerScope will print its most recent calibration data.

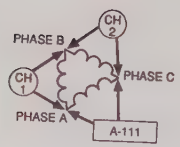
6) Press the SELF TEST key to test the PowerScope.

(There is no more HELP!)

==========

3. Three-Phase Delta

3. Three-Phase Delta

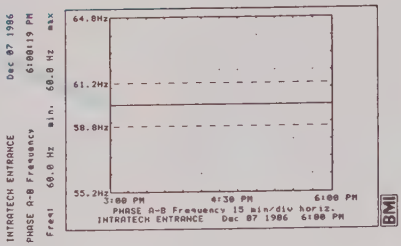


Nom. freq.: 60.0 Hz

Range: 45 Hz to 450 Hz

Use the number keys to enter the nominal frequency of the line you are monitoring.

A typical settings are 50.0 Hz, 60.0 Hz, 400.0 Hz, or 415.0 Hz.

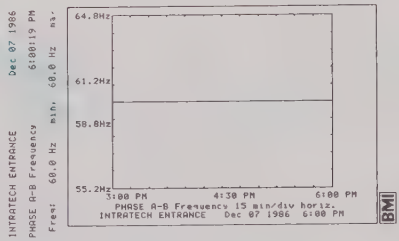


Freq. tol.: 1.2 Hz

Range: 0.4Hz to 135.0Hz

Use the number keys to enter a threshold for the line-frequency deviation.

The range is 0.2 to 50% of the nominal frequency, and is entered in Hertz. A typical value is 2% of the nominal frequency.



For example, if the nominal setting is 50.0 Hz,
the frequency tolerance range is 0.1 Hz (0.2%) to 25 Hz (50%).
If the frequency is 60 Hz, the frequency tolerance range is 0.1 Hz to 30 Hz.
If the frequency is 400 Hz, the frequency tolerance range is 0.8 Hz to 200 Hz.
If the frequency is 415 Hz, the frequency tolerance range is 0.8 Hz to 207 Hz.

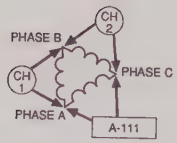
HELP!

```
======================================

Enter the nominal line frequency of
the line you are monitoring.  This
provides a reference to the monitor
from which it can base its measure-
ments. Typical values are 50.0 Hz,
60.0 Hz, and 400.0 Hz.  The
acceptable range is 45.0 Hz to
450.0 Hz.

(Press HELP! again for general infor-
mation on the Setup Menu.)

======================================
```

```
======================================

Enter in Hertz the amount of line
frequency deviation from nominal that
you are willing to tolerate before the
PowerScope reports a disturbance. The
range is 0.2% to 50% of your nominal
frequency setting.  A typical value
is 2% of your nominal frequency.

For example, if your nominal
frequency setting is 60 Hz., the range
is 0.1 Hz (0.2%) to 30.0 Hz (50%).
The default setting for 60 Hz is
1.2 Hz (2%).

(Press HELP! again for general infor-
mation on the Setup Menu.)

======================================
```


3. Three-Phase Delta

3. Three-Phase Delta

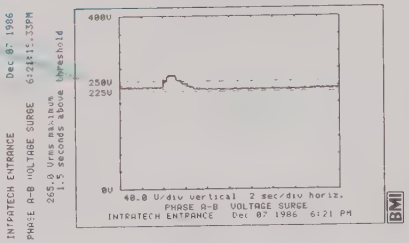


Surge volt: 250.0Vrms

Range: 1.0Vrms to 750.0Vrms

Use the number keys to enter the high-voltage threshold for line-to-neutral.

The usual value is about 10% above the nominal voltage.



The acceptable range is 1.0 Vrms to 750.0 Vrms.

This is a line-to-neutral disturbance graph.

The surge-voltage threshold also determines the full scale RMS voltage as follows:

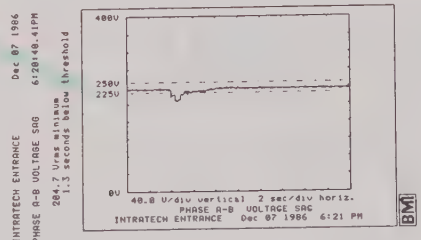
Voltage Surge Threshold Table

Surge Threshold	Full Scale
1.0 – 6.2 Vrms	10.0 Vrms
6.3 – 12.5 Vrms	20.0 Vrms
12.6 – 25.0 Vrms	40.0 Vrms
25.1 – 62.5 Vrms	100.0 Vrms
62.6 - 125.0 Vrms	200.0 Vrms
125.1 - 166.5 Vrms	250.0 Vrms
166.6 - 250.0 Vrms	400.0 Vrms
250.1 - 600.0 Vrms	800.0 Vrms

Range: 0.0Vrms to 749.9Vrms

Use the number keys to enter the low voltage threshold for line-to-neutral.

The usual value is about 15% below the nominal voltage.



The acceptable range is 0.0 to 749.9 Vrms.

This is a line-to-neutral disturbance graph.

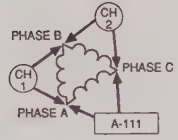
HELP!

```
====================================

Use the number keys to enter the
high voltage threshold.  The usual
value is about 10% above the nominal
voltage.  The acceptable range is
1.0 Vrms to 750.0 Vrms.

(Press HELP! again for general
information on the Setup Menu.)

====================================
```

```
====================================

Use the number keys to enter the low
voltage threshold.  The usual value is
about 15% below the nominal voltage.
The acceptable range is 0.0 Vrms to
749.9 Vrms.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```


3. Three-Phase

3: Three-Phase Delta

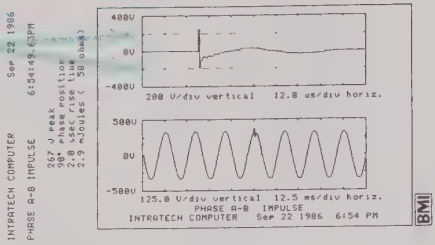


Impulse thr: 200 Vpk

Range: 20 Vpk to 6000 Vpk

Use the number keys to enter the value of the smallest impulse you wish the PowerScope to report.

Typical thresholds are in the range of 100-250 volts. You may select any value from 20 Vpk to 6000 Vpk.



Phase A-to-B impulse graph.

HELP!

==========

Use the number keys to enter the value of the smallest impulse you wish the PowerScope to report. Typical thresholds are in the range of 100-250 volts. You may select any value from 20 to 6000 volts.

(Press HELP! again for more information on answering this question.)

==========

==========

If you choose AUTO impulse ranging in the Key Operator Menu, the PowerScope will choose a full scale impulse range according to the following table:

Impulse threshold	Impulse full scale
20 Vpk - 50 Vpk	100 Vpk
51 Vpk - 100 Vpk	200 Vpk
101 Vpk - 200 Vpk	400 Vpk
201 Vpk - 400 Vpk	800 Vpk
401 Vpk - 800 Vpk	1600 Vpk
801 Vpk - 1600 Vpk	3200 Vpk
1601 Vpk - 6000 Vpk	6400 Vpk

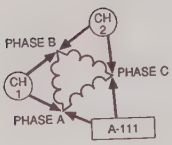
However, if you choose MANUAL impulse ranging in the Key Operator Menu, you will be asked to select a full scale range yourself.

(Press HELP! again for general information on the Setup Menu.)

==========

1 Introduction
2 Single-Phase
3 Three-Phase Delta
4 Three-Phase Wye
5 DC or Custom Setups
6 Probes and Accessories
7 The Series 2460
8 Key Operator Menu
9 Communications
10 Operation
11 Loading Paper
12 Troubleshooting
13 Specifications
14 Graphs
15 Recommended Thresholds
16 Index
Your Comments Please

3. Three-Phase Delta



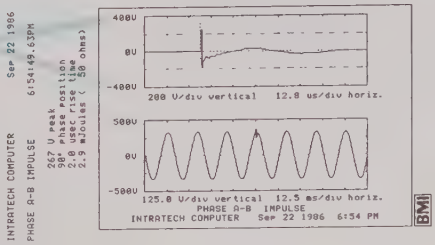
NOTE: The next question will only appear if you have Impulse Ranging in the Key Operator Menu set to MANUAL.

Imp. range: 400 Vpk

Possible selections: See the following table.

Use the VALUE UP/ VALUE DOWN keys to select the full-scale impulse range for phase A-to-B.

The selections depend on the impulse threshold, e.g., for a 20-24 Vpk threshold, there are 2 full-scale ranges available, 100 or 200 volts full scale.



Phase A-to-B impulse graph.

Manual Impulse Ranging Table

Impulse Threshold	Available Full-Scale Ranges
20-24 Vpk	+/- 100 or 200 volts full-scale
24-49 Vpk	+/- 100, 200 or 400 volts full-scale
50 Vpk	+/- 100, 200, 400 or 800 volts full-scale
51-99 Vpk	+/- 200, 400 or 800 volts full-scale
100 Vpk	+/- 200, 400, 800 or 1600 volts full-scale
101-199 Vpk	+/- 400, 800 or 1600 volts full-scale
200 Vpk	+/- 400, 800, 1600 or 3200 volts full-scale
201-399 Vpk	+/- 800, 1600 or 3200 volts full-scale
400 Vpk	+/- 800, 1600, 3200 or 6400 volts full-scale
401-800 Vpk	+/- 1600, 3200 or 6400 volts full-scale
801-1600 Vpk	+/- 3200 or 6400 volts full-scale
1601-6400 Vpk	+/- 6400 volts full-scale

Automic Impulse Ranging Table

If you selected AUTO Impulse Ranging in the Key Operator Menu (or plan to), the full-scale impulse range will be selected for you as follows:

If Impulse Threshold selected in previous question is between...	The Impulse Range will set automatically to...
20 - 50 volts	+/- 100 volts
51 - 100 volts	+/- 200 volts
101 - 200 volts	+/- 400 volts
201 - 400 volts	+/- 800 volts
401 - 800 volts	+/- 1600 volts
801 - 1600 volts	+/- 3200 volts
1601- 6000 volts	+/- 6400 volts

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to select the full scale impulse range. (If you want the PowerScope to choose a range for you automatically, use the Key Operator menu to select AUTO impulse ranging. The PowerScope will automatically select a range that will give you a good compromise between resolution and dynamic range.)

(Press HELP! for more information on selecting full scale ranges.)

==========

==========

The full scale impulse ranges are:

100 Vpk
200 Vpk
400 Vpk
800 Vpk
1600 Vpk
3200 Vpk
6400 Vpk

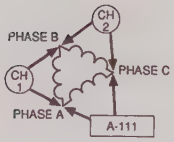
To preserve resolution, the PowerScope will not allow you to select a full scale range that is less than two times your impulse threshold or greater than 16 times your impulse threshold:

Full scale	Acceptable thresholds
100 Vpk	20 Vpk - 50 Vpk
200 Vpk	20 Vpk - 100 Vpk
400 Vpk	20 Vpk - 200 Vpk
800 Vpk	50 Vpk - 400 Vpk
1600 Vpk	100 Vpk - 800 Vpk
3200 Vpk	200 Vpk - 1600 Vpk
6400 Vpk	400 Vpk - 6000 Vpk

(Press HELP! again for general information on the Setup Menu.)

==========

3. Three-Phase Delta

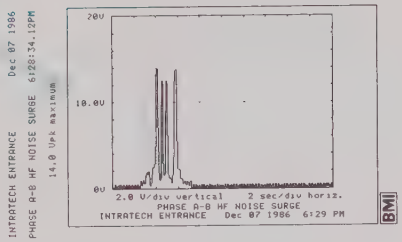


Hi.freq.noise: 10.0V

Range: 1.0 to 19.9 volts

Use the number keys to enter the high-frequency noise disturbance threshold (measured in peak-to-peak volts).

A typical threshold is 5.0 Vpk. The acceptable range is 1.0 Vpk to 19.9 Vpk.



Phase A-B high frequency noise disturbance graph.

NOTE: If you are using a BMI A-111 AC/DC/Impulse Probe for phase C-A, additional questions will be added to the Setup menu. Go on to the next page for these further questions.

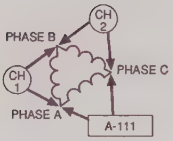
If you are using other probes for environmental monitoring there will be additional questions. See Chapter 6 for an explanation of environmental thresholds.

If no probes are connected, this will be the end of the Setup menu questions.

HELP!

```
====================================

Use the number keys to enter the
high frequency noise disturbance
threshold (measured in peak-to-peak
volts).  A typical threshold is
5.0 Vpk.  The acceptable range is
1.0 Vpk to 19.9 Vpk.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```

3. Three-Phase Delta



AC/DC Impulse Probe

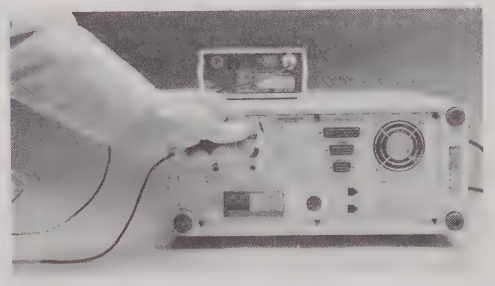
To monitor the third phase (phase C-A) of 3-phase delta using the 2400 PowerScope, you will need a BMI A-111 AC/DC/Impulse probe. The questions that follow are added to the Setup menu when the A-111 is connected.

Sensor setup: D

Selections: A, B, C or D

Use the VALUE UP/ VALUE DOWN keys to select which probe you will be setting thresholds for now.

For the sake of example, let's say you have an AC/DC/Impulse Probe plugged into Channel D. The Sensor setup menu will automatically show Channel D.

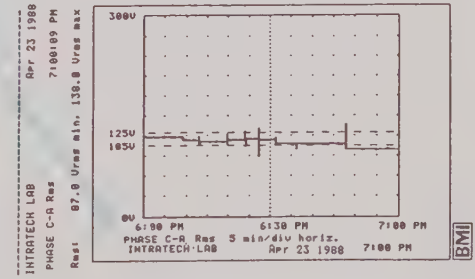


Connecting a BMI Model A-111 AC/DC/Impulse probe.

Name: PHASE C-A

Enter up to 9 characters from the keypad to name this probe.

The BMI A-111 AC/DC/ Impulse Probe is automatically named PHASE A-C. To change this name use the keypad.



For example, to enter a P, press the 7PQR key two times. On the first press, a 7 will appear, on the second press a P will appear. The third press would be a Q, and the fourth press an R. Press the right arrow key to advance the cursor. Press the 0 SPACE key twice to enter a space.

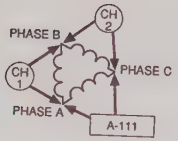
HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
choose which probe you will set
thresholds for now.  The choices you
have will depend on which environ-
mental channels you have probes
plugged into. The four environmental
channels are lettered A-D.

(Press HELP! again for general infor-
mation on the Setup Menu).

====================================
```

```
====================================

You may enter up to 9 characters from
the keyboard to name this AC/DC
Voltage/Impulse probe.

Use the left and right arrow keys to
move the flashing cursor.  Use the
number keys to enter both letters and
numbers.  For example, to enter the
letter 'B', push the '2ABC' key three
times.  Then move the flashing cursor
to the next character.

(There is no more HELP!)

====================================
```


3. Three-Phase Delta

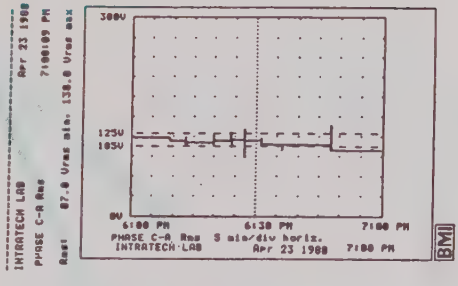
3. Three-Phase Delta



Sensor Mode: Rms

Selections: Rms
Vdc

Use the VALUE UP/ VALUE DOWN keys to choose whether you will use this probe to monitor alternating or direct current.



This is a 1-Hr summary strip chart.

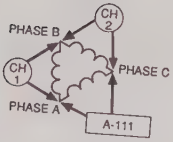
```
------------------------------------------
INTRATECH LAB                 Apr 23 1988
PHASE C-A VOLTAGE SAG         4:45:58 PM
(Sensor B)

 Voltage below          105.0 Vrms
```

```
------------------------------------------
INTRATECH LAB                 Apr 23 1988
PHASE C-A VOLTAGE SAG END     4:45:58 PM
(Sensor B)

 Minimum voltage:        72.0 Vrms
```

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the mode of this AC/DC/Impulse
probe.   Your choices are:

RMS  -  This should be selected for
        monitoring AC lines.
        It will make true
        RMS measurements.

VDC  -  This should be selected for
        monitoring batteries and
        DC supplies.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```

3. Three-Phase Delta

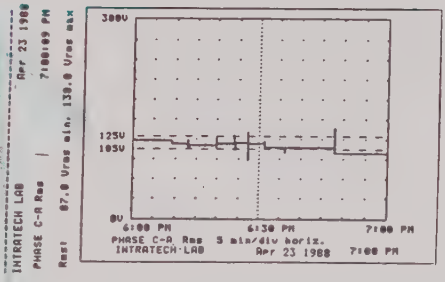


PHASE C-A high: 125.0Vrms

Selections: 1.0 to 600.0 Vrms
1.0 to 99.9 Vdc

Use the number keys to enter the high-voltage threshold for this probe.

The acceptable range is 1.0 to 600.0 Vrms, or 1.0 to 99.9 Vdc. Usually the threshold should be set to 10% above the nominal voltage. A typical value is 125.0 Vrms, or 5.5 Vdc.



Rms 1-Hr strip chart.

```
INTRATECH LAB                    Apr 23 1988

PHASE C-A VOLTAGE SURGE          4:44:44 PM
(Sensor B)

 Voltage above          125.0 Vrms

INTRATECH LAB                    Apr 23 1988

PHASE C-A VOLT SURGE END         4:44:50 PM
(Sensor B)

 Maximum voltage=       132.0 Vrms
```

Rms disturbance text report.

The full-scale range is determined by the high-voltage threshold as follows:

Rms Full-scale Range Table

High-voltage threshold	Full-scale range
1.0 - 15.0 Vrms	20.0 Vrms
15.1 - 130.0 Vrms	150.0 Vrms
130.1 - 260.0 Vrms	300.0 Vrms
260.1 - 600.0 Vrms	600.0 Vrms

Vdc Full-scale Range Table

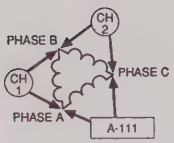
High-voltage threshold	Full-scale range
1.0 - 7.0 Vdc	10.0 Vdc
7.1 - 17.0 Vdc	20.0 Vdc
17.1 - 99.9 Vdc	100.0 Vdc

HELP!

```
====================================

Use the number keys to enter the high
voltage threshold for this probe.  The
usual value is about 10% above the
nominal voltage.  The acceptable range
is 1.0 Vrms to 600.0 Vrms.  A typical
value is 125.0 Vrms.

(Press HELP! again for information on
how threshold settings affect the
full scale range of this probe.)

====================================
```

```
====================================

The high voltage threshold that
you select will also determine the
full scale setting of this probe, as
follows:

   High Voltage        Full Scale
    threshold           setting
-----------------     ----------

  1.0 -  15.0 Vrms      20.0 Vrms
 15.1 - 130.0 Vrms     150.0 Vrms
130.1 - 260.0 Vrms     300.0 Vrms
260.1 - 600.0 Vrms     600.0 Vrms

(Press HELP! again for general infor-
mation on the Setup menu.)

====================================
```


Three-Phase Delta
Your Comments Please

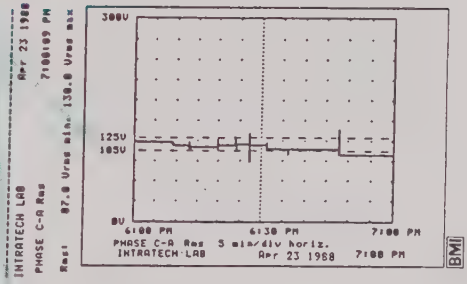


PHASE C-A low 105.0Vrms

Selections: 0.0 to 599.9 Vrms
0.0 to 99.8 Vdc

Use the number keys to enter the low-voltage threshold for this probe.

The acceptable range is 0.0 to 599.9 Vrms, or 0.0 to 99.8 Vdc. Usually the setting should be made to 10% below the nominal voltage. A typical value is 105.0 Vrms, or 4.5 Vdc.



Rms 1-Hr strip chart.

```
INTRATECH LAB                    Apr 23 1988

PHASE C-A VOLTAGE SAG            4:45:58 PM
(Sensor B)

 Voltage below          105.0 Vrms
```

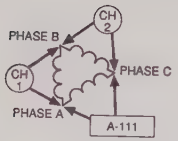
```
INTRATECH LAB                    Apr 23 1988

PHASE C-A VOLTAGE SAG END        4:45:58 PM
(Sensor B)

 Minimum voltage:       72.0 Vrms
```

Rms disturbance text report.

HELP!

```
====================================

Use the number keys to enter the low
voltage threshold for this sensor. The
usual value is about 10% below the
nominal voltage.  The acceptable range
is 0.0 Vrms to 599.9 Vrms.  A typical
value is 105.0 Vrms.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```

3: Three-Phase Delta

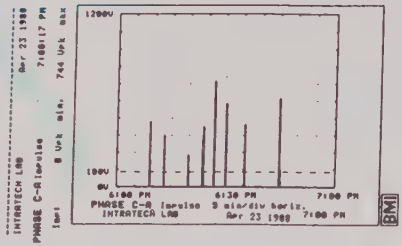


AC/DC Impulse probe

PHASE C-A Imp 100.0Vpk

Use the number keys to enter the impulse threshold.

The acceptable impulse threshold settings for this probe depend on the high-voltage threshold you set in the previous question as shown in the table below.



Impulse 1-Hr strip chart.

```
BMI COMPUTER RM                    Apr 27 1988

PHASE C-A IMPULSE            9:33:20.41AM

          203 V peak
          195° Phase Position
          0.0 usec rise time
est.   12 mJoules (  50 ohms)
```

Impulse text report.

AC Impulse Ranging Table

High Voltage Threshold AC	Full Scale Setting AC	Acceptable Impulse Threshold AC
1.0 - 15.0 Vrms	20.0 Vrms	8.0 - 80.0 Vpk
15.1 - 130.0 Vrms	150.0 Vrms	60.0 - 600 Vpk
130.1 - 260.0 Vrms	300.0 Vrms	120.0 - 1200 Vpk
260.1 - 600.0 Vrms	600.0 Vrms	240.0 - 2400 Vpk

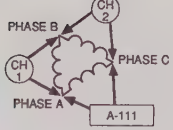
DC Impulse Ranging Table

High Voltage Threshold DC	Full Scale Setting DC	Acceptable Impulse Threshold DC
1.0 - 7.0 Vdc	10.0 Vdc	4 - 40 Vpk
7.1 - 17.0 Vdc	20.0 Vdc	8 - 80 Vpk
17.1 - 99.9 Vdc	100.0 Vdc	40 - 400 Vpk

NOTE: If you have more than one A-111 AC/DC/Impulse probe plugged in, then the Setup questions (pages 3-18 to 3-26) will be repeated. If you have other probes, refer to chapter 6, Probes and Accessaries, page 6-1.

HELP!

```
====================================

Use the number keys to enter the
impulse threshold for this sensor. The
acceptable range of impulse thresholds
depends on the high voltage threshold
that you have selected for this probe.

(Press HELP! again for information on
how high voltage thresholds affect
impulse thresholds if monitoring DC.
Press HELP! twice for information
on how high voltage thresholds affect
impulse thresholds if monitoring AC).


====================================

This chart applies if you are
monitoring DC:

 High Voltage      Acceptable impulse
  threshold           thresholds
--------------    ------------------

 1.0 -  7.0 Vdc     4 Vpk -  40 Vpk
 7.1 - 17.0 Vdc     8 Vpk -  80 Vpk
17.1 - 99.9 Vdc    40 Vpk - 400 Vpk

====================================

====================================

If you are monitoring AC, this
chart applies:

   High Voltage     Acceptable impulse
    threshold          threshold
-----------------  ------------------

  1.0 -  15.0 Vrms    8 Vpk -   80 Vpk
 15.1 - 130.0 Vrms   60 Vpk -  600 Vpk
130.1 - 260.0 Vrms  120 Vpk - 1200 Vpk
260.1 - 600.0 Vrms  240 Vpk - 2400 Vpk

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```



The Report Menu lets you choose the graphs and summary reports your PowerScope prints. For a complete description of graphs and summary reports, see Appendix A.

Quick Guide to the Setup Menu

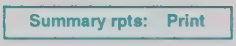
1. Press the SETUP MENU key.

2. Answer the questions in the menu using the VALUE UP/VALUE DOWN keys.

3. Press the down arrow key to go on to the next question.

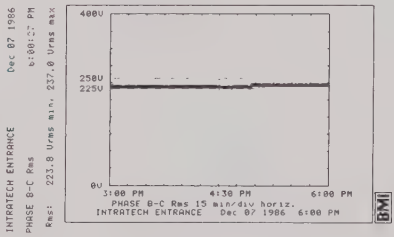
4. Press the HELP! key if you want further explanation about the question or on what to do next.

If you get the following message in the display, it's because the PowerScope has strip charts from the previous monitoring period.



Possible selections: Print
Clear

Use the VALUE UP/ VALUE DOWN keys to choose whether you want the pending strip charts.



This is a summary strip chart.

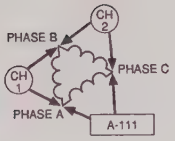
If you want them printed then erased, position PRINT in the display, then press the down arrow. If you want them erased immediately, position CLEAR in the display, then press the down arrow.

Then, press the SETUP MENU key again and proceed.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select PRINT or CLEAR and then
use the DOWN ARROW key to enter
the menu you have selected.

If you select PRINT, the summary data
and strip charts that have been
gathered so far by the PowerScope will
be printed and then reset. If you
select CLEAR, all of the summary
data and strip charts will be reset
without printing.

If you don't want to lose any summary
data, you may return to the Monitor
mode by pressing the MONITOR key.

(There is no more HELP!)

====================================
```

3 Three-Phase Delta



Threshold report: On

Selections: On
Off

Use the VALUE UP/ VALUE DOWN keys to turn the Threshold Report on or off.

Your PowerScope prints the Threshold Report after you press the MONITOR key. The Threshold Report shows all the current settings. Generally, you should leave this report on.

```
************************************

BNI 2400 SITE                Jan 01 1988

THRESHOLD REPORT               12:37 AM

Type:      3-phase delta

PHASE-PHASE THRESHOLDS (Channels 1,2)
      Surge voltage:  125.0 Vrms
      Sag voltage:    105.0 Vrms
      Impulse:          200 Vpk
      High freq noise: 10.0 Vpk
      High frequency:  61.2 Hz
      Low  frequency:  58.8 Hz
      Wave shape:       20% variation
      Minimum duration: 0.1 cycles
      Line impedance:    50 ohms
      Hysteresis:       1.0%

PHASE C-A THRESHOLDS (Sensor A)
      Surge voltage:  125.0 Vrms
      Sag voltage:    105.0 Vrms
      Impulse:          100 Vpk

VOLTAGE B THRESHOLDS (Sensor B)
      Surge voltage:  125.0 Vrms
      Sag voltage:    105.0 Vrms
      Impulse:          100 Vpk

SUMMARY REPORT INTERVAL:  Off

Internal UPS time:   5 minutes.


Initial waveshape graphs turned off.
```

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to turn the Threshold Report on or off This report should normally be left on.

(Press HELP! again for more information on Threshold Reports).

==========

The Threshold Report is the list of thresholds and settings your PowerScope can print automatically before it begins monitoring.

(If you turn the Threshold Report on now, you can still omit it when you begin monitoring by pressing the MONITOR key followed immediately by the UP ARROW key.)

(Press HELP! again for general information on the Report Menu).

==========

The usual sequence for operating the PowerScope monitor is:

1) Press the SETUP MENU key and answer the questions. To go on to the next question, press the Down Arrow.

2) Connect the monitor to the power line. (See the HELP! message in the Setup Menu for the 'TYPE:' question.)

3) Press the MONITOR key to monitor the power line. Your reports will be printed automatically.

(Press HELP! again for general information on the six modes of operation.)

==========

==========

The PowerScope monitor can be in one of six modes:

1) Press the SETUP MENU key to program the Setup Menu. Use the up arrow and the down arrow key to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu. (You may want to press 'HELP!' when you have selected the type of power line you are going to monitor. This will give you installation instructions.) By pressing the SETUP MENU key, then immediately pressing the UP ARROW key, you will enter the Key Operator Menu. This menu will give you control of the detailed operation of the PowerScope.

2) Press the STATUS key to print the Status Report. This report tells you the present voltage, frequency, and noise on each of the channels. This report can be especially useful when you're trying to set the thresholds correctly. It's also useful for checking to see if you've installed the monitor correctly.

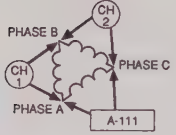
3) Press the REPORT MENU key to enter the Report menu. Use the up arrow and the down arrow to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu.

4) Press the MONITOR key to start monitoring the power line. The PowerScope will print a complete copy of your setup, and show you the initial waveshapes on each channel (if you have requested them in the Report Menu). Then it will print a disturbance report every time a power disturbance occurs.

(Continued on page 3-33.)

1. Three-Phase Delta

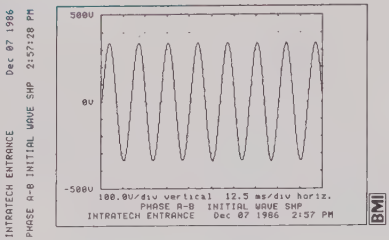
3: Three-Phase Delta



Initial waves: On

Selections: On
Off

Use the VALUE UP/ VALUE DOWN keys to turn the initial waveshape graphs on or off.



Your PowerScope prints initial waveshape graphs after the Threshold Report. These graphs show the initial condition of the sine waves. Generally, you should leave this report on.

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to turn the Initial Waveshape Report on or off. This report should normally be left on.

(Press HELP! again for more information on the Initial Waveshape Report).

==========

==========

The Initial Waveshape Report shows the condition of the sine waves at the beginning of the monitoring session. Initial waveshapes may give you additional information on the condition of the power lines.

(Press HELP! again for general information on the Report Menu).

==========

(Continued from page 3-31.)

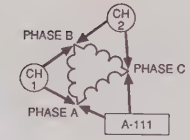
5) Press the CALIBRATION key to calibrate your PowerScope. To calibrate your PowerScope, you must connect an external A-016 Precision Calibrator to the PowerScope; If you haven't connected one, the PowerScope will print its most recent calibration data.

6) Press the SELF TEST key to test the PowerScope.

(There is no more HELP!)

==========

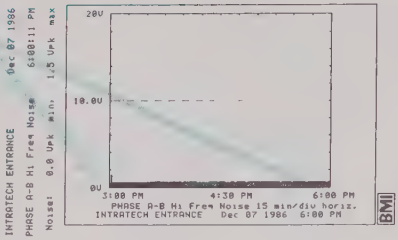
3 Three-Phase Delta



Strip charts: 3 Hr

Selections: 24 Hr
12 Hr
6 Hr
3 Hr
1 Hr
Off

Use the VALUE UP/ VALUE DOWN keys to select the strip chart interval.



Phase A-to-B 3-Hr strip chart.

```
INTRATECH ENTRANCE                Dec 07 1986

STRIP CHART REPORT                        6:00 PM
 From  3:00 PM  To  6:00 PM

PHASE A-B  (Channel 1)
 Rms:    223.4 Vrms min,  237.0 Vrms max
 Noise:    0.0 Vpk  min,    1.5 Vpk  max
 Freq:    60.0 Hz   min,   60.0 Hz   max
 Imp:        0 counted

PHASE B-C  (Channel 2)
 Rms:    223.8 Vrms min,  237.0 Vrms max
 Noise:    0.0 Vpk  min,    1.7 Vpk  max
 Freq:    60.0 Hz   min,   60.0 Hz   max
 Imp:        0 counted
```

This is a summary strip chart report.

If you choose:

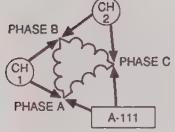
24 hr – strip charts will be printed every 24 hours at midnight.
12 hr – strip charts will be printed every 12 hours beginning at 12:00.
6 hr – strip charts will be printed every 6 hours beginning at 6:00.
3 hr – strip charts will be printed every 3 hours beginning at 3:00.
1 hr – strip charts will be printed every hour on the hour.
Off – no long-term summary information will be printed.

NOTE: Whatever strip chart interval you choose here will appear in the forthcoming questions.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the time interval between
printing strip charts and summary
reports.

Possible selections are: 24 hours,
12 hours, 6 hours, 3 hours, 1 hour,
or OFF.  The interval that you choose
impacts the choices offered you in the
next series of questions.

(Press HELP! for more information on
selecting strip chart summary
reports).

====================================

====================================

If you choose, for example, 12-hour
strip chart summaries, your choices
in the next questions regarding
individual strip chart summary reports
will include 12-hour strip charts.
(If you choose 3-hour strip charts
here, your choices in the next
questions will include 3-hour strip
charts, and so on.)

(Press HELP! for general information
on the Setup Menu.)

====================================
```

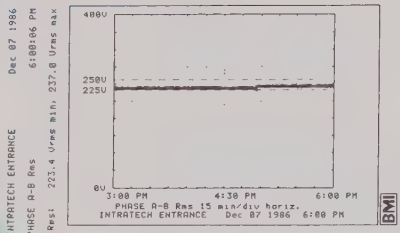

1. Simplex
2. Three-Phase Wye
3. Three-Phase Delta
4. Three-Phase Wye
5. Define Custom Ranges
6. Printout Options
7. Communications Setup
8. Key Operator Menu
9. Communications Menu
10. Operation
11. Loading Paper
12. Troubleshooting
13. Specifications
14. Graphs
15. Recommended Thresholds
16. Index
17. Your Comments Please



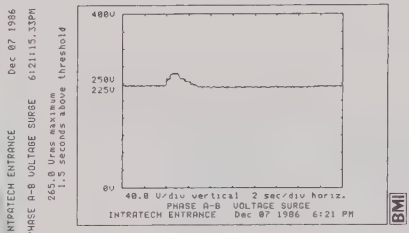
Phase A-B Rms: Both

Selections: Both
3 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting you want for the Rms signal on the A-to-B phase.



3-Hr strip chart: phase A-to-B Rms.



Graph: phase A-to-B surge.

If you choose :

3-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

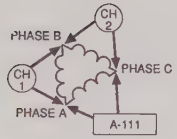
Both - your PowerScope will print both strip charts and graphs.

Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

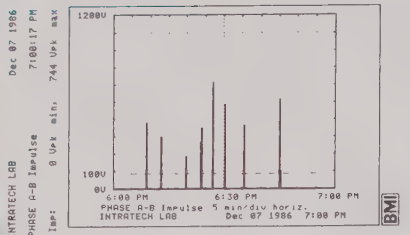
3. Three-Phase Delta



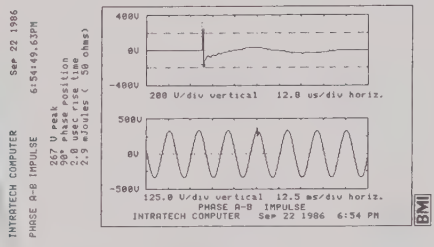
Phase A-B Imp: Both

Selections: Both
1 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for impulses on phase A-to-B.



1-Hr strip chart: phase A-to-B impulse.



Graph: phase A-to-B impulse.

If you choose:

Both - your PowerScope will print both strip charts and graphs.

1-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

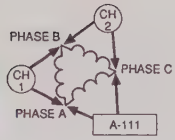
Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Off - no disturbance graphs or strip charts will be printed for this signal; however the maximum reading of this signal will be reported textually in the summary reports.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

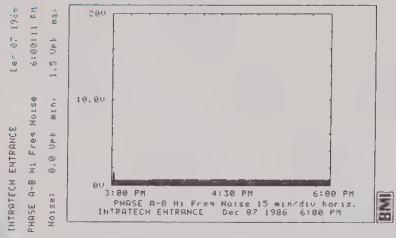

3. Three-Phase Delta
Probes
Operation
Loading Paper
Troubleshooting
Specifications
B Recommended Thresholds



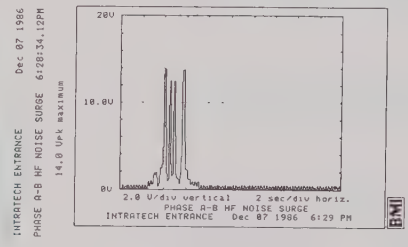
Phase A-B HFN: Both

Selections: Both
3 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the high-frequency noise disturbances on phase A-to-B.



3-Hr strip chart: phase A-to-B high-frequency noise.



Graph: phase A-to-B high-frequency noise.

If you choose :

3-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

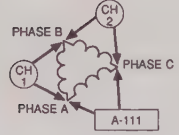
Both - your PowerScope will print both strip charts and graphs.

Off - no text disturbance reports or strip charts will be printed for this signal, however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

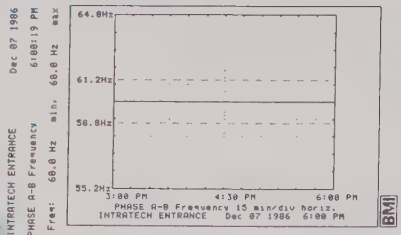
1. Three-Phase Delta



Phase A-B Freq: Both

Selections: Both
3 Hr
Text
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the phase A-to-B frequency signal.



3-Hr strip chart: phase A-to-B frequency.

```
INTRATECH ENTRANCE          Dec 07 1986
PHASE A-B HIGH FREQ.     6:32:48.06PM
     Frequency above:         61.2 Hz

-----------------------------------------
INTRATECH ENTRANCE          Dec 07 1986
PHASE A-B HI FREQ END    6:32:55.01PM
     Maximum frequency:       62.0Hz
```

Text report: phase A-to-B frequency disturbance.

If you choose :

Both - your PowerScope will print both strip charts and text reports.

3-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance text reports.

Text - your PowerScope will print disturbance text reports of this signal, but won't print strip charts.

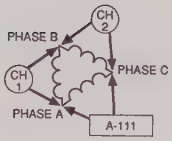
Off - no disturbance text reports or strip charts will be printed for this signal, however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a textual
     disturbance reports of this
     signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance reports.

TEXT -
     Your PowerScope will print a
     textual report of all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither textual reports nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu,
you will not have the choice of
strip chart summaries in this
question.

(Press HELP! again for general infor-
mation on the Report Menu.)

=====================================
```


2. Single-phase
3. Three-Phase Delta
Three-Phase Wye
5. DC or Current
6. Probes and
7. If you have a
8. Key Operator
9. Communications
10. Operation
11. Loading Paper
12. Troubleshooting
13. Specifications
14. Graphs
A. Recommended Thresholds
Index
Your Comments Please

3. Three Phase Delta

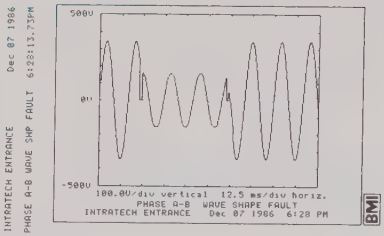


PHASE A-B Wave: On

Selections: On
Off

Use the VALUE UP/ VALUE DOWN keys to turn line-to-neutral A waveshape fault graphs on or off.

Generally, these graphs should be left on.



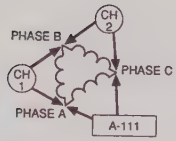
Phase A-to-B waveshape fault graph.

Note:
The Report menu questions for Phase B-C are identical to the questions for Phase A-B. See pages 3-36 to 3-44 for descriptions of these questions. In our example, Phase A-B uses channel 1, Phase B-C uses channel 2, and Phase C-A is monitored by an A-111 AC/DC/Impulse Probe. Turn to the next page for a description of the Report menu questions for the A-111 AC/DC/Impulse Probe.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
turn on or off the Waveshape fault
disturbance reporting for this signal.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

Three Phase Delta



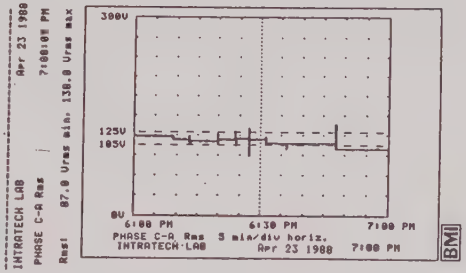
Using an A-111 AC/DC/Impulse probe for phase C-A

NOTE: The following questions appear if you are using a BMI A-111 AC/DC/Impulse Probe to monitor phase C-A . The A-111 must be plugged into one of the environmental sensor channels on the back of the 2400 PowerScope.

PHASE C-A Rms: Both

Selections: Both
1 Hr
Text
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the voltage signal of the AC/DC/ Impulse Probe.



1-Hr strip chart: Rms.

```
----------------------------------------
INTRATECH LAB                Apr 23 1988

PHASE C-A VOLTAGE SURGE      4:44:44 PM
(Sensor 8)

 Voltage above          125.0 Vrms


----------------------------------------
INTRATECH LAB                Apr 23 1988

PHASE C-A VOLT SURGE END     4:44:50 PM
(Sensor 8)

 Maximum voltage!       132.0 Vrms


----------------------------------------
```

Text report: Rms.

If you choose:

Both - your PowerScope will print both strip charts and text reports.

1-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance text reports of this signal.

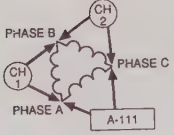
Text - your PowerScope will print disturbance text reports of this signal, but won't print strip charts.

Off - no disturbance text reports or strip charts will be printed for this signal; however the maximum reading of this signal will be reported textually in the summary reports.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a textual
     disturbance reports of this
     signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance reports.

TEXT -
     Your PowerScope will print a
     textual report of all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither textual reports nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu,
you will not have the choice of
strip chart summaries in this
question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

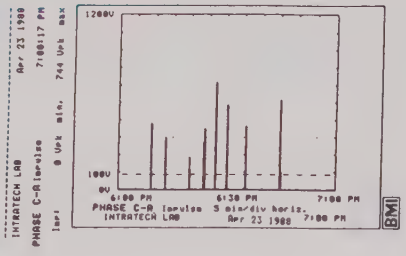
3. Three-Phase Delta



PHASE C-A Imp: Both

Selections: Both
1 Hr
Text
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for Phase C-A impulses.



1-Hr strip chart: Impulse signal from AC/DC/Impulse probe.

```
BMI COMPUTER RM                Apr 27 1988
PHASE C-A IMPULSE          9:33:20.41AM

          203 V Peak
          195° Phase Position
          8.0 usec rise time
     est.  12 mJoules (  50 ohms)
```

Text report: Impulse.

If you choose:

Both - your PowerScope will print both strip charts and text reports.

1-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance text reports of this signal.

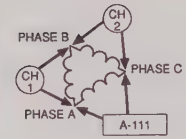
Text - your PowerScope will print disturbance text reports of this signal, but won't print strip charts.

Off - no disturbance text reports or strip charts will be printed for this signal; however the maximum reading of this signal will be reported textually in the summary reports.

End of Report Menu.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

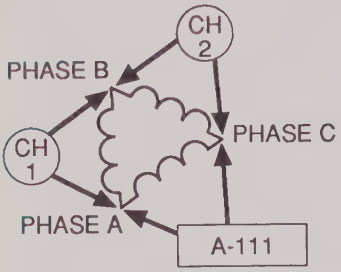


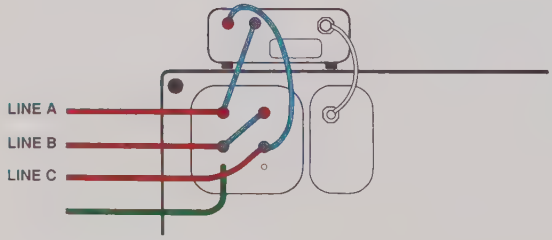
Part 3 discusses how to connect your PowerScope to monitor three-phase delta power.

Use a BMI A-111 AC/DC/Impulse Probe for a Third Channel

To monitor all lines of a 3-phase delta system (phase A to B, B to C and C to A) requires three channels. Two of these channels are in the 2400; you will need a BMI A-111 AC/DC/Impulse Probe to provide the third channel.

The A-111 AC/DC/Impulse Probe provides text reports and summary strip charts of disturbances, but does not produce the high-resolution graphs. Use your best judgement in deciding which two lines to monitor with the PowerScope, and which one to monitor with the A-111. The following configuration uses the PowerScope for line A to B and B to C, while the A-111 is used for line C to A.





Connecting to Three-Phase Delta

1. Using a green ground cable, connect ground to Channel 1 (green).

2. Using a red cable, connect line A to a blue jumper cable, then into Channel 1 red (positive).

3. Connect the other end of the jumper cable to the A-111 black terminal (negative).

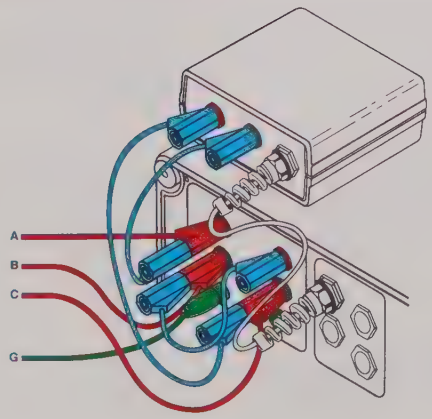
4. Using a red cable, connect line B to a blue jumper cable, then into Channel 1 black (negative).

5. Connect the other end of the jumper cable into Channel 2 red (positive).

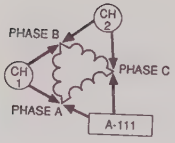
6. Using a red cable, connect line C to a blue jumper cable, then into Channel 2 black (negative).

7. Connect the other end of the jumper cable to the A-111 red terminal (positive).

WARNING
You are working with high voltages that cause burns and lethal shocks. Connect the safety earth ground first. USE STANDARD SAFETY PRECAUTIONS.



3. Three-Phase Delta



Summary of Setup menu and Report menus:
Menu prompts appear in the order shown. To scroll through the questions, press the Up Arrow or the Down Arrow. The indented options are chosen by pressing the VALUE UP/VALUE DOWN keys, and the range values (in parenthesis) are entered using the keypad.

Summary Reports: Print
Clear

Site: BMI 2400 SITE
(Any 15 character name)

Type: Single phase
Dual 1-phase
3-phase delta
3-phase wye
Ind. Channels

Nom. freq.: 60.0 Hz
(45-450)

Freq. tol.: 1.2 Hz
(0.2-50%)

Surge volt: 125 Vrms
(1.0-750.0 Vrms)

Sag volt: 105.0 Vrms
(0.0-749.9 Vrms)

Impulse thr: 200Vpk
(20 Vpk-6000 Vpk)

[Imp. range: 400 Vpk]*
(±100-6400 Vpk)

Hi.freq.noise: 10.0V
(1.0-19.9 V)

If you are using a BMI A-111 AC/DC/Impulse Probe to monitor the third phase, then the following questions will be automatically added to the Setup menu.

Sensor Setup: A
(A, B, C or D)

Name: PHASE C-A
(Any 9 Characters)

Sensor Mode: Rms

PHASE C-A Hi: 125.0 Vrms
(1-600 Vrms)

PHASE C-A Lo: 105.0 Vrms
(0-599.9 Vrms)

PHASE C-A Imp.: 200.0 Vpk
(10-2400 Vpk)

End of Setup menu.

* Appears only if Impulse ranging set to MANUAL in the Key Operator Menu

Summary Reports: Print
Clear

Threshold report: On
Off

Initial Waves: On
Off

Strip charts: 24Hr
12Hr
6Hr
3Hr
1Hr
Off

PHASE A-B Rms: Both
Strip chart interval
Graph
Off

PHASE A-B Imp: Both
Strip chart interval
Graph
Off

PHASE A-B HFN: Both
Strip chart interval
Graph
Off

PHASE A-B Freq.: Both
Strip chart interval
Text
Off

PHASE A-B Wave: On
Off

PHASE B-C Rms: Both
Strip chart interval
Graph
Off

PHASE B-C Imp: Both
Strip chart interval
Graph
Off

PHASE B-C HFN: Both
Strip chart interval
Graph
Off

PHASE B-C Freq.: Both
Strip chart interval
Text
Off

PHASE B-C Wave: On
Off

If you are using a BMI A-111 AC/DC/Impulse Probe to the monitor the third phase, then the following questions will be automatically added to the Report menu.

PHASE C-A Rms: Both
Strip chart interval*
Text
Off

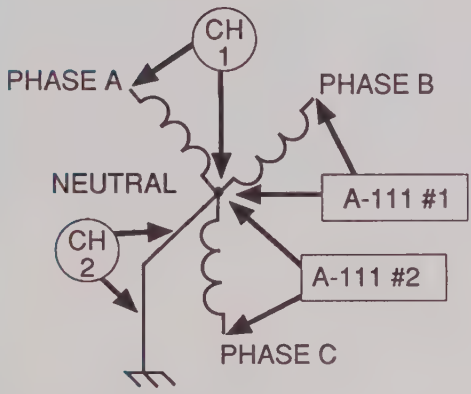
PHASE C-A Imp.: Both
Strip chart interval*
Text
Off

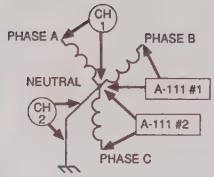
End of report menu.

* Strip chart intervals may be selected at 1, 3, 6, 12 or 24 hours, whatever was selected at the beginning of the Report menu.

Chapter 4

Three-Phase Wye





This chapter shows you how to set up the PowerScope if you want to monitor three-phase wye power. *You will need two BMI A-111 AC/DC/Impulse Probes along with your PowerScope to monitor all channels of three-phase wye.*

Quick Guide to the Setup Menu

1. Press the SETUP MENU key.

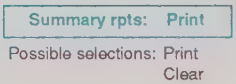
2. Answer the questions in the menu using the VALUE UP/VALUE DOWN keys or the number keypad.

3. Press the down arrow key to go onto the next question.

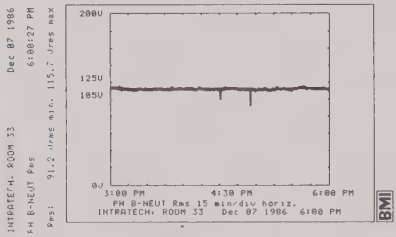
4. Press the HELP! key if you want further explanation about the question or on what to do next.

Press the SETUP MENU key now.

If you get the following message in the display, it's because the PowerScope has strip charts from the previous monitoring period.



Use the VALUE UP/ VALUE DOWN keys to choose whether you want the pending strip charts.



This is a summary strip chart.

If you want them printed then erased, position PRINT in the display, then press the down arrow.
If you want them erased immediately, position CLEAR in the display, then press the down arrow.

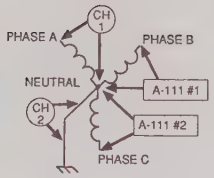
Then, press the SETUP MENU key again and proceed.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select PRINT or CLEAR and then
use the DOWN ARROW key to enter
the menu you have selected.

If you select PRINT, the summary data
and strip charts that have been
gathered so far by the PowerScope will
be printed and then reset. If you
select CLEAR, all of the summary
data and strip charts will be reset
without printing.

If you don't want to lose any summary
data, you may return to the Monitor
mode by pressing the MONITOR key.

(There is no more HELP!)

====================================
```

4. Three-Phase Wye

4. Three-Phase Wye

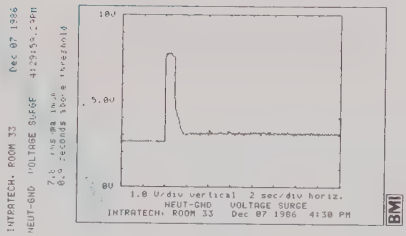


Site: INTRATECH, ROOM 3

Use the number keys to enter the name of the site where you will be monitoring the power.

The name can be up to 20 characters long.

Use the left arrow and right arrow keys to move the flashing cursor.



Use the number keys to enter both letters and numbers; for example, to enter the letter "K", press the 5JKL key 3 times. On the first press, a 5 will appear; on the second, a J will appear, and on the third, a K will appear.

Now move the flashing cursor to the next position by pressing the right arrow key. Press the 0 SPACE button twice to enter a space. Press the down arrow key to go on to the next question.

HELP!

==========

You may enter up to 20 characters from the keyboard to identify the site that you are monitoring.

Use the left and right arrow keys to move the flashing cursor.

Use the number keys to enter both letters and numbers. For example, to enter the letter 'B', push the '2ABC' key three times.

(Press HELP! again for general information on the Setup Menu.)

==========

==========

The Setup Menu contains questions that define the operating parameters of your PowerScope. Specifically, it asks you to name the monitoring site, state what type of power each channel will monitor, and specify thresholds for each measurement.

The questions in the Setup Menu change automatically depending on what type of power you assign each channel and if you have probes plugged into the environmental channels.

(Press HELP! again for general information on the operating sequence.)

==========

==========

The usual sequence for operating the PowerScope monitor is:

1) Press the SETUP MENU key and answer the questions. To go on to the next question, press the Down Arrow.

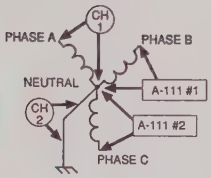
2) Connect the monitor to the power line. (See the HELP! message in the Setup Menu for the 'TYPE:' question.)

3) Press the MONITOR key to monitor the power line. Your reports will be printed automatically.

(Press HELP! again for general information on the six modes of operation.)

==========

4. Three-Phase Wye



3-phase wye setup

Type: 3-phase wye

Selections: Single Phase
Dual Phase
3 phase delta
3 phase wye
Ind. channels

Use the VALUE UP/ VALUE DOWN keys to select 3-phase wye.

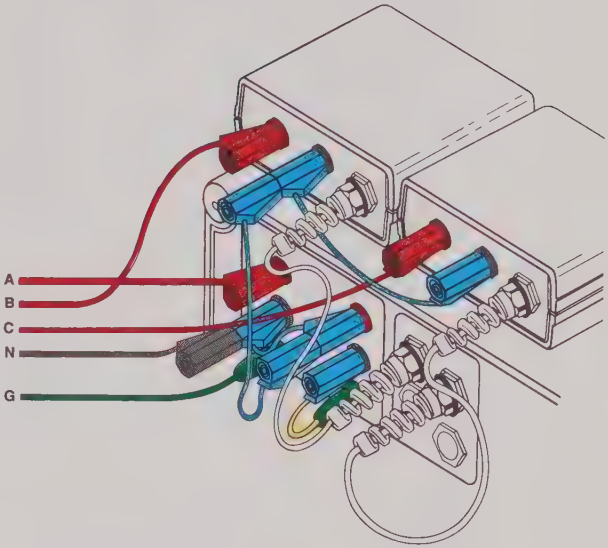
For three-phase wye, you will have the following setup:

Channel 1:
Phase A-to-Neutral

Channel 2:
Neutral-to-Ground

Sensor A:
Phase B-to-Neutral

Sensor B:
Phase C-to-Neutral



Press the HELP! key for information on connecting your PowerScope to Three-Phase Wye power, or see Part 3 of this chapter on page 4-60.

WARNING
You are working with high voltages that cause burns and lethal shocks. Connect the safety earth ground first. USE STANDARD SAFETY PRECAUTIONS.

HELP!

==========

Select '3 phase Y' to monitor a 5-wire, 3-phase system, with separate neutral and ground wires.

You will need two A-111 AC/DC/Impulse probes, connected to Environmental Sensor inputs 'A' and 'B'.

To install the PowerScope on a 3-phase 'Y' line, make the following connections:

Channel 1 GREEN terminal:	SAFETY GROUND
Channel 1 Red terminal:	Phase A
Channel 1 Black terminal:	Neutral
Channel 2 Red terminal:	Neutral
Channel 2 Black terminal:	Ground
Environmental Sensor A:	
A-111 Red terminal:	Phase B
A-111 Black terminal:	Neutral
Environmental Sensor B:	
A-111 Red terminal:	Phase C
A-111 Black terminal:	Neutral

(Press HELP! again for general information on the Setup Menu.)

==========

==========

The PowerScope monitor can be in one of six modes:

1) Press the SETUP MENU key to program the Setup Menu. Use the up arrow and the down arrow key to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu. (You may want to press 'HELP!' when you have selected the type of power line you are going to monitor. This will give you installation instructions.)

   By pressing the SETUP MENU key, then immediately pressing the UP ARROW key, you will enter the Key Operator Menu. This menu will give you control of the detailed operation of the PowerScope.

2) Press the STATUS key to print the Status Report. This report tells you the present voltage, frequency, and noise on each of the channels. This report can be especially useful when you're trying to set the thresholds correctly. It's also useful for checking to see if you've installed the monitor correctly.

3) Press the REPORT MENU key to enter the Report menu. Use the up arrow and the down arrow to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu.

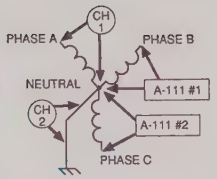
4) Press the MONITOR key to start monitoring the power line. The PowerScope will print a complete copy of your setup, and show you the initial waveshapes on each channel (if you have requested them in the Report Menu). Then it will print a disturbance report every time a power disturbance occurs.

5) Press the CALIBRATION key to calibrate your PowerScope. To calibrate your PowerScope, you must connect an external A-016 Precision Calibrator to the PowerScope; If you haven't connected one, the PowerScope will print its most recent calibration data.

6) Press the SELF TEST key to test the PowerScope.

(There is no more HELP!)

4. Three-Phase Wye

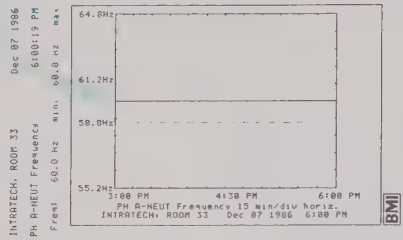


Nom. freq.: 60.0Hz

Range: .45Hz to 450Hz

Use the number keys to enter in the nominal frequency of the line you are monitoring.

Typical settings are 50.0 Hz, 60.0 Hz, 400.0 Hz, or 415.0 Hz.

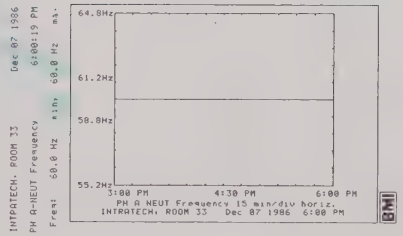


Freq. tol.: 1.2Hz

Range: 0.4Hz to 135.0Hz

Use the number keys to enter a threshold for line-frequency deviation.

The range is 0.2% to 50% of the nominal frequency, and is entered in Hertz. A typical value is 2% of the nominal frequency.



For example, if the nominal frequency setting is 60.0 Hz, the frequency tolerance range is 0.12 Hz (0.2%) to 30 Hz (50%). If the frequency is 50.0 Hz, the frequency tolerance range is 0.1 Hz to 25 Hz. If the frequency is 400.0 Hz, the frequency tolerance range is 0.8 Hz to 200 Hz. If the frequency is 415.0 Hz, the frequency tolerance range is 0.83 Hz to 207.5 Hz.

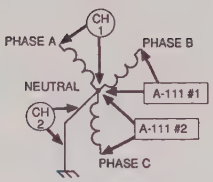
HELP!

```
=====================================

Enter the nominal line frequency of
the line you are monitoring.  This
provides a reference to the monitor
from which it can base its measure-
ments. Typical values are 50.0 Hz,
60.0 Hz, and 400.0 Hz.  The
acceptable range is 45.0 Hz to
450.0 Hz.

(Press HELP! again for general infor-
mation on the Setup Menu.)

=====================================
```

```
=====================================

Enter in Hertz the amount of line
frequency deviation from nominal that
you are willing to tolerate before the
PowerScope reports a disturbance. The
range is 0.2% to 50% of your nominal
frequency setting.   A typical value
is 2% of your nominal frequency.

For example, if your nominal
frequency setting is 60 Hz., the range
is 0.1 Hz (0.2%) to 30.0 Hz (50%).
The default setting for 60 Hz is
1.2 Hz (2%).

(Press HELP! again for general infor-
mation on the Setup Menu.)

=====================================
```

4. Three-Phase Wye

4. Three-Phase Wye



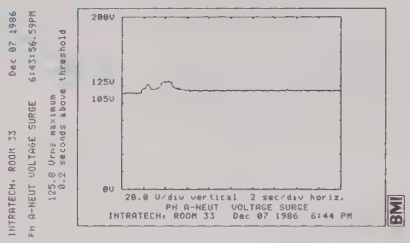
Surge volt: 125.0Vrms

Range: 1.0Vrms to 750.0Vrms

Use the number keys to enter the high voltage threshold for line-to-neutral.

The usual value is about 10% above the nominal voltage.

The acceptable range is 1.0 Vrms to 750.0 Vrms.



Phase A-to-neutral surge graph.

The surge-voltage threshold also determines the full scale RMS voltage as follows:

Voltage Surge Threshold Table

Surge Threshold	Full Scale
1.0 – 6.2 Vrms	10.0 Vrms
6.3 – 12.5 Vrms	20.0 Vrms
12.6 – 25.0 Vrms	40.0 Vrms
25.1 – 62.5 Vrms	100.0 Vrms
62.6 - 125.0 Vrms	200.0 Vrms
125.1 - 166.5 Vrms	250.0 Vrms
166.6 - 250.0 Vrms	400.0 Vrms
250.1 - 750.0 Vrms	800.0 Vrms

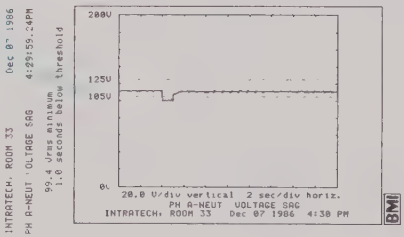
Sag volt: 105.0Vrms

Range: 0.0Vrms to 749.9Vrms

Use the number keys to enter the low voltage threshold for line-to-neutral.

The usual value is about 15% below the nominal voltage.

The acceptable range is 0.0 to 749.9 Vrms.



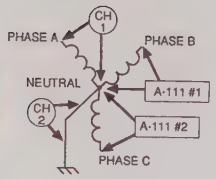
Phase A-to-neutral sag graph.

HELP!

```
=======================================

Use the number keys to enter the
high voltage threshold.  The usual
value is about 10% above the nominal
voltage.  The acceptable range is
1.0 Vrms to 750.0 Vrms.

(Press HELP! again for general
information on the Setup Menu.)

=======================================
```

```
=======================================

Use the number keys to enter the low
voltage threshold.  The usual value is
about 15% below the nominal voltage.
The acceptable range is 0.0 Vrms to
749.9 Vrms.

(Press HELP! again for general infor-
mation on the Setup Menu.)

=======================================
```

4. Three-Phase Wye

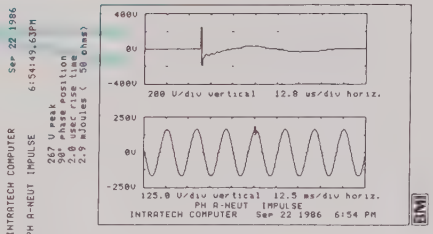


Impulse thr: 200 Vpk

Range: 20 Vpk to 6000 Vpk

Use the number keys to enter the smallest impulse you wish the PowerScope to report

Typical thresholds are in the range of 100-250 volts. You may select any value from 20 Vpk to 6000 Vpk.



Phase A-to-neutral impulse graph.

HELP!

==========

Use the number keys to enter the value of the smallest impulse you wish the PowerScope to report. Typical thresholds are in the range of 100-250 volts. You may select any value from 20 to 6000 volts.

(Press HELP! again for more information on answering this question.)

==========

==========

If you choose AUTO impulse ranging in the Key Operator Menu, the PowerScope will choose a full scale impulse range according to the following table:

Impulse threshold	Impulse full scale
20 Vpk - 50 Vpk.	100 Vpk
51 Vpk - 100 Vpk	200 Vpk
101 Vpk - 200 Vpk	400 Vpk
201 Vpk - 400 Vpk	800 Vpk
401 Vpk - 800 Vpk	1600 Vpk
801 Vpk - 1600 Vpk	3200 Vpk
1601 Vpk - 6000 Vpk	6400 Vpk

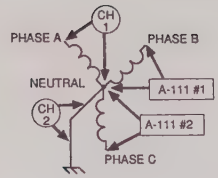
However, if you choose MANUAL impulse ranging in the Key Operator Menu, you will be asked to select a full scale range yourself.

(Press HELP! again for general information on the Setup Menu.)

==========

4. Three-Phase Wye

4: Three-Phase Wye

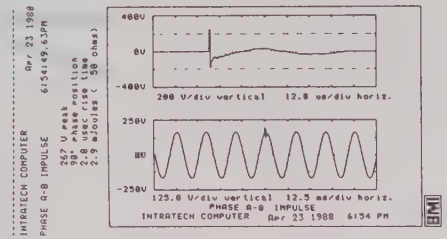


NOTE: The next question will only appear if you have Impulse Ranging in the Key Operator Menu set to MANUAL.

Imp. range: 100 Vpk

Possible selections: See the following table.

Use the VALUE UP/ VALUE DOWN keys to select the full-scale impulse range.



Phase A-to-neutral impulse graph.

Manual Impulse Ranging Table

Impulse Threshold	Available Full-Scale Ranges
20-24 Vpk	+/- 100 or 200 volts full-scale
24-49 Vpk	+/- 100, 200 or 400 volts full-scale
50 Vpk	+/- 100, 200, 400 or 800 volts full-scale
51-99 Vpk	+/- 200, 400 or 800 volts full-scale
100 Vpk	+/- 200, 400, 800 or 1600 volts full-scale
101-199 Vpk	+/- 400, 800 or 1600 volts full-scale
200 Vpk	+/- 400, 800, 1600 or 3200 volts full-scale
201-399 Vpk	+/- 800, 1600 or 3200 volts full-scale
400 Vpk	+/- 800, 1600, 3200 or 6400 volts full-scale
401-800 Vpk	+/- 1600, 3200 or 6400 volts full-scale
801-1600 Vpk	+/- 3200 or 6400 volts full-scale
1601-6400 Vpk	+/- 6400 volts full-scale

The selections depend on the impulse threshold, e.g. for a 20-24 Vpk threshold, there are 2 full-scale ranges availabe, 100 or 200 volts full scale.

If you selected AUTO Impulse Ranging in the Key Operator Menu (or plan to), the full-scale impulse range will be selected for you as follows:

Automic Impulse Ranging Table

If Impulse Threshold selected in previous question is between...	The Impulse Range will set automatically to...
20 - 50 volts	+/- 100 volts
51 - 100 volts	+/- 200 volts
101 - 200 volts	+/- 400 volts
201 - 400 volts	+/- 800 volts
401 - 800 volts	+/- 1600 volts
801 - 1600 volts	+/- 3200 volts
1601- 6000 volts	+/- 6400 volts

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to select the full scale impulse range. (If you want the PowerScope to choose a range for you automatically, use the Key Operator menu to select AUTO impulse ranging. The PowerScope will automatically select a range that will give you a good compromise between resolution and dynamic range.)

(Press HELP! for more information on selecting full scale ranges.)

==========

==========

The full scale impulse ranges are:

100 Vpk
200 Vpk
400 Vpk
800 Vpk
1600 Vpk
3200 Vpk
6400 Vpk

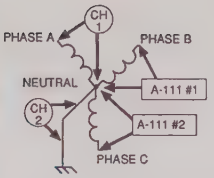
To preserve resolution, the PowerScope will not allow you to select a full scale range that is less than two times your impulse threshold or greater than 16 times your impulse threshold:

Full scale	Acceptable thresholds
100 Vpk	20 Vpk - 50 Vpk
200 Vpk	20 Vpk - 100 Vpk
400 Vpk	20 Vpk - 200 Vpk
800 Vpk	50 Vpk - 400 Vpk
1600 Vpk	100 Vpk - 800 Vpk
3200 Vpk	200 Vpk - 1600 Vpk
6400 Vpk	400 Vpk - 6000 Vpk

(Press HELP! again for general information on the Setup Menu.)

==========

4. Three-Phase Wye

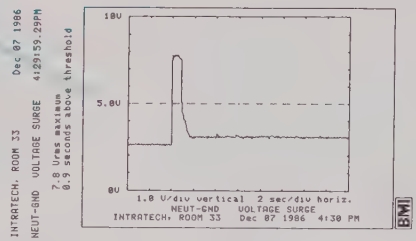


Neut-Gnd: 5.0 Vrms

Range: 0.1 Vrms to 99.9 Vrms

Use the number keys to enter the surge voltage threshold for neutral-to-ground.

You may select any value from 0.1 Vrms to 99.9 Vrms. (Typical thresholds range between 1.0 and 10.0 Vrms.)



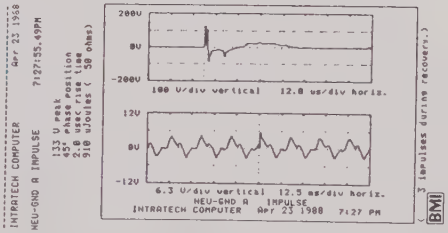
Neutral-to-ground surge graph.

N-G Imp thr: 100 Vpk

Range: 20.0Vrms to 6000.0Vrms

Use the number keys to enter the smallest neutral-to-ground impulse you want the PowerScope to graph.

Typical thresholds range between 50-250 volts. You may select any value from 20 volts to 6000 volts.



Neutral-to-ground impulse graph.

HELP!

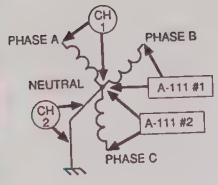
```
=====================================

Use the number keys to enter the
acceptable ac voltage difference
between the neutral and ground lines
being monitored by the PowerScope.
Typical thresholds are in the range
of 1.0-10.0 Vrms.  You may select any
value from 0.1 Vrms to 99.9 Vrms.

(Press HELP! again for general infor-
mation on the Setup Menu.)

=====================================
```

```
=====================================

Use the number keys to enter the
value of the smallest neutral-ground
impulse you wish the PowerScope to
report. Typical thresholds are in the
range of 50-250 volts.  You may
select any value from 20 to 6000
volts.

(Press HELP! again for general infor-
mation on the Setup Menu.)

=====================================
```


4. Three-Phase Wye

10. Operation

Your Comments Please

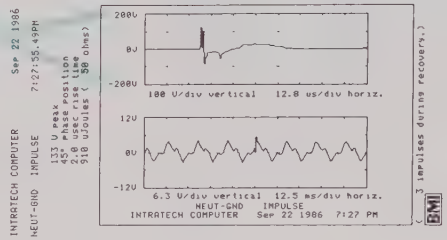


NOTE: You'll only get the next question if you have Impulse Ranging in the Key Operator Menu set to MANUAL.

N-G Imp. range: 200 Vpk

Possible selections: See the following table.

Use the VALUE UP/ VALUE DOWN keys to select the full-scale impulse range for neutral-to-ground.



Neutral-to-ground impulse graph.

The selections depend on the impulse threshold, e.g. for a 20-24 Vpk threshold, there are 2 full-scale ranges available, 100 or 200 volts full-scale.

Manual Impulse Ranging Table

Impulse Threshold	Available Full-Scale Ranges
20-24 Vpk	+/-100 or 200 volts full-scale
24-49 Vpk	+/-100, 200 or 400 volts full-scale
50 Vpk	+/-100, 200, 400 or 800 volts full-scale
51-99 Vpk	+/-200, 400 or 800 volts full-scale
100 Vpk	+/-200, 400, 800 or 1600 volts full-scale
101-199 Vpk	+/-400, 800 or 1600 volts full-scale
200 Vpk	+/-400, 800, 1600 or 3200 volts full-scale
201-399 Vpk	+/-800, 1600 or 3200 volts full-scale
400 Vpk	+/-800, 1600, 3200 or 6400 volts full-scale
401-800 Vpk	+/-1600, 3200 or 6400 volts full-scale
801-1600 Vpk	+/-3200 or 6400 volts full-scale
1601-6400 Vpk	+/-6400 volts full-scale

If you selected AUTO Impulse Ranging in the Key Operator Menu (or plan to), the full-scale impulse range will be selected for you as follows:

Automatic Impulse Ranging Table

The Impulse Range will set automatically to...	If Impulse Threshold selected in previous question is between...
+/- 100 volts	20 - 50 volts
+/- 200 volts	51 - 100 volts
+/- 400 volts	101 - 200 volts
+/- 800 volts	201 - 400 volts
+/- 1600 volts	401 - 800 volts
+/- 3200 volts	801 - 1600 volts
+/- 6400 volts	1601- 6000 volts

HELP!

Use the VALUE UP/VALUE DOWN keys to select the full scale impulse range. (If you want the PowerScope to choose a range for you automatically, use the Key Operator menu to select AUTO impulse ranging. The PowerScope will automatically select a range that will give you a good compromise between resolution and dynamic range.)

(Press HELP! for more information on selecting full scale ranges.)

The full scale impulse ranges are:

100 Vpk
200 Vpk
400 Vpk
800 Vpk
1600 Vpk
3200 Vpk
6400 Vpk

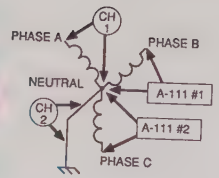
To preserve resolution, the PowerScope will not allow you to select a full scale range that is less than two times your impulse threshold or greater than 16 times your impulse threshold:

Full scale	Acceptable thresholds
100 Vpk	20 Vpk - 50 Vpk
200 Vpk	20 Vpk - 100 Vpk
400 Vpk	20 Vpk - 200 Vpk
800 Vpk	50 Vpk - 400 Vpk
1600 Vpk	100 Vpk - 800 Vpk
3200 Vpk	200 Vpk - 1600 Vpk
6400 Vpk	400 Vpk - 6000 Vpk

(Press HELP! again for general information on the Setup Menu.)

---

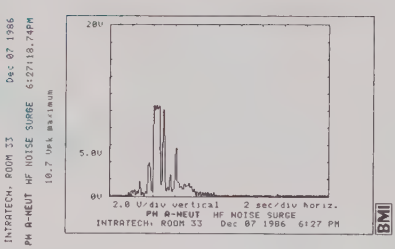
4. Three-Phase Wye



Hi-freq. noise: 5.0V

Range: 1.0V to 19.9V

Use the number keys to enter the high-frequency noise disturbance threshold (measured in peak-to-peak volts).



High-frequency noise disturbance graph.

A typical threshold is 5.0 Vpk. The acceptable range is 1.0 Vpk to 19.9 Vpk.

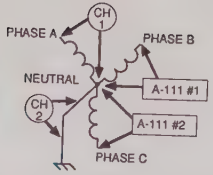
Note: To monitor all phases of 3-phase wye using the 2400 or 2460 PowerScope, you will need two BMI A-111 AC/DC/Impulse Probes. If you have such probes connected, additional questions will be added here, as detailed on the following pages.

HELP!

```
====================================

Use the number keys to enter the
high frequency noise disturbance
threshold (measured in peak-to-peak
volts).  A typical threshold is
5.0 Vpk.  The acceptable range is
1.0 Vpk to 19.9 Vpk.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```


4. Three-Phase Wye

4. Three-Phase Wye

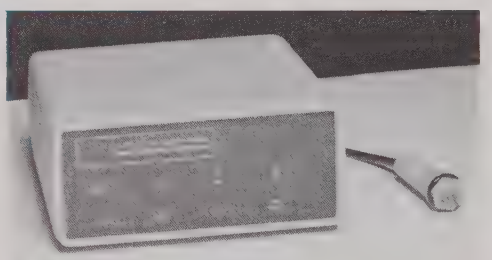


Sensor setup: A

Selections: A, B, C or D

Use the VALUE UP/ VALUE DOWN keys to select which probe you will be setting thresholds for now.

For the sake of example, let's say you have an AC/DC Impulse Probe plugged into Channel A.The Sensor setup menu will automatically show Channel A.

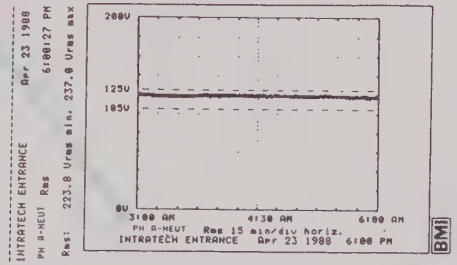


BMI Model A-111 AC/DC/Impulse probe.

Name: PH B-NEUT

Enter up to 9 characters from the keypad to name this probe.

The BMI A-111 AC/DC Impulse Probe is automatically named PH B-NEUT. To change this name use the keypad.



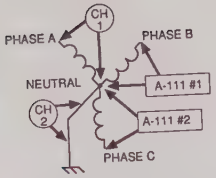
Use the number keys to enter both letters and numbers; for example, to enter the letter 'K', press the '5JKL' key three times. On the first press a 5 will appear; on the second a J will appear; and on the third a K will appear. Now move the flashing cursor to the next position by pressing the right arrow key. Press the 0 SPACE button twice to enter a space. Press the down arrow key to go on to the next question.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
choose which probe you will set
thresholds for now.  The choices you
have will depend on which environ-
mental channels you have probes
plugged into. The four environmental
channels are lettered A-D.

(Press HELP! again for general infor-
mation on the Setup Menu).

====================================
```

```
====================================

You may enter up to 9 characters from
the keyboard to name this AC/DC
Voltage/Impulse probe.

Use the left and right arrow keys to
move the flashing cursor.  Use the
number keys to enter both letters and
numbers.  For example, to enter the
letter 'B', push the '2ABC' key three
times.  Then move the flashing cursor
to the next character.

(There is no more HELP!)

====================================
```

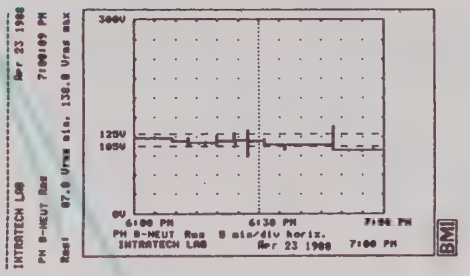
4: Three-Phase Wye



Sensor mode: Rms

Selections: Rms
Vdc

Use the VALUE UP/ VALUE DOWN keys to choose whether you will use this probe to monitor alternating or direct current.



This is a 1-Hr summary strip chart.

```
----------------------------------------
INTRATECH LAB                Apr 23 1988

LNE-NEU B VOLTAGE SURGE      4:44:44 PM
(Sensor A)

 Voltage above          125.0 Vrms


----------------------------------------
INTRATECH LAB                Apr 23 1988

LNE-NEU B VOLT SURGE END     4:44:50 PM
(Sensor A)

 Maximum voltage:       132.0 Vrms


----------------------------------------
```

This is a voltage disturbance text report.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the mode of this AC/DC/Impulse
probe.   Your choices are:

RMS  -  This should be selected for
        monitoring AC lines.
        It will make true
        RMS measurements.

VDC  -  This should be selected for
        monitoring batteries and
        DC supplies.

(Press HELP! again for general infor-
mation on the Setup Menu.)

=====================================
```

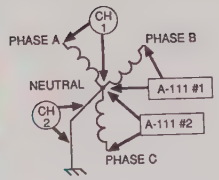

Single-phase

4. Three-Phase Wye

DC or Custom Setups

Your Comments Please

4. Three-Phase Wye

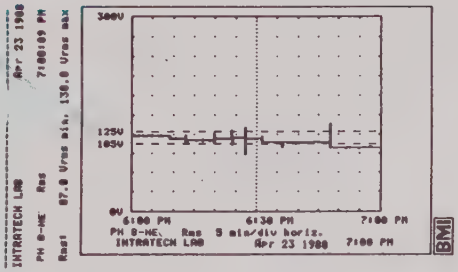


PH B-NEUT hi: 125.0Vrms

Selections: 1.0 to 600.0 Vrms
1.0 to 99.9 Vdc

Use the number keys to enter the high-voltage threshold for this probe.

The acceptable range is 1.0 to 600.0 Vrms, or 1.0 to 99.9 Vdc. Usually the threshold should be set to 10% above the nominal voltage. A typical value is 125.0 Vrms, or 5.5 Vdc.



Rms 1-Hr strip chart.

```
INTRATECH LAB                    Apr 23 1988

PH B-NEUT VOLTAGE SURGE          4:44:44 PM
(Sensor A)

 Voltage above          125.0 Vrms
```

```
INTRATECH LAB                    Apr 23 1988

PH B-NEUT VOLT SURGE END         4:44:50 PM
(Sensor A)

 Maximum voltage:       132.0 Vrms
```

Rms disturbance text report.

The full-scale range is determined by the high-voltage threshold as follows:

Rms Full-scale Range Table

High-voltage threshold	Full-scale range
1.0 - 15.0 Vrms	20.0 Vrms
15.1 - 130.0 Vrms	150.0 Vrms
130.1 - 260.0 Vrms	300.0 Vrms
260.1 - 600.0 Vrms	600.0 Vrms

Vdc Full-scale Range Table

High-voltage threshold	Full-scale range
1.0 - 6.0 Vdc	10.0 Vdc
6.1 - 16.0 Vdc	20.0 Vdc
16.1 - 99.9 Vdc	100.0 Vdc

HELP!

==========

Use the number keys to enter the high voltage threshold for this probe. The usual value is about 10% above the nominal voltage. The acceptable range is 1.0 Vrms to 600.0 Vrms. A typical value is 125.0 Vrms.

(Press HELP! again for information on how threshold settings affect the full scale range of this probe.)

==========

==========

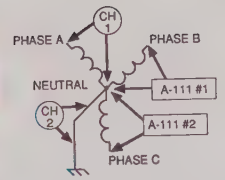
The high voltage threshold that you select will also determine the full scale setting of this probe, as follows:

High Voltage threshold	Full Scale setting
1.0 - 15.0 Vrms	20.0 Vrms
15.1 - 130.0 Vrms	150.0 Vrms
130.1 - 260.0 Vrms	300.0 Vrms
260.1 - 600.0 Vrms	600.0 Vrms

(Press HELP! again for general information on the Setup menu.)

==========

4. Three-Phase Wye

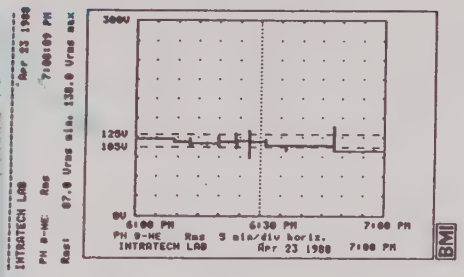


PH B-NEUT lo 105.0Vrms

Selections: 0.0 to 599.9 Vrms
0.0 to 99.8 Vdc

Use the number keys to enter the low-voltage threshold for this probe.

The acceptable range is 0.0 to 599.9 Vrms, or 0.0 to 99.8 Vdc. Usually the setting should be made to 10% below the nominal voltage. A typical value is 105.0 Vrms, or 4.5 Vdc.



Rms 1-Hr strip chart.

```
INTRATECH LAB                          Apr 23 1988
PH B-NEUT VOLTAGE SAG                  4:45:58 PM
(Sensor A)

 Voltage below          105.0 Vrms
```

```
INTRATECH LAB                          Apr 23 1988
PH B-NEUT VOLTAGE SAG END              4:45:58 PM
(Sensor A)

 Minimum voltage:        72.0 Vrms
```

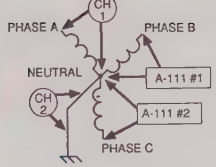
Rms disturbance text report.

HELP!

```
=====================================

Use the number keys to enter the low
voltage threshold for this sensor. The
usual value is about 10% below the
nominal voltage.  The acceptable range
is 0.0 Vrms to 599.9 Vrms.   A typical
value is 105.0 Vrms.

(Press HELP! again for general infor-
mation on the Setup Menu.)

=====================================
```


4 Three-Phase Wye

4. Three-Phase Wye



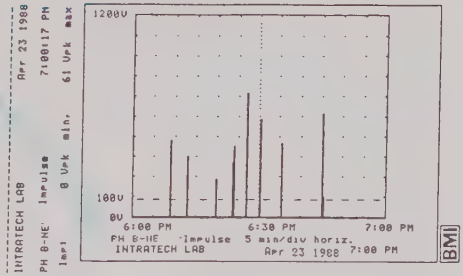
AC/DC Impulse probe

PH B-NE Imp 100.0Vpk

Possible selections: see the following table.

Use the number keys to enter the impulse threshold.

The acceptable impulse threshold settings for this probe depend on the high-voltage threshold you set in the previous question as follows:



Impulse 1-Hr strip chart.

```
INTRATECH LAB                    Apr 23 1988
PH B-NEUT Impulse                4:45:29 PM
(Sensor B)

 Peak voltage:                   700 Vpk
```

Impulse text report.

AC Impulse Ranging Table

High Voltage Threshold AC	Full Scale Setting AC	Acceptable Impulse Threshold AC
1.0 - 15.0 Vrms	20.0 Vrms	8.0 - 80.0 Vpk
15.1 - 130.0 Vrms	150.0 Vrms	60.0 - 600 Vpk
130.1 - 260.0 Vrms	300.0 Vrms	120.0 - 1200 Vpk
260.1 - 600.0 Vrms	600.0 Vrms	240.0 - 2400 Vpk

DC Impulse Ranging Table

High Voltage Threshold DC	Full Scale Setting DC	Acceptable Impulse Threshold DC
1.0 - 7.0 Vdc	10.0 Vdc	4 - 40 Vpk
7.1 - 17.0 Vdc	20.0 Vdc	8 - 80 Vpk
17.1 - 99.9 Vdc	100.0 Vdc	40 - 400 Vpk

NOTE: If you have more than one A-111 AC/DC/Impulse probe plugged in, then the Setup questions (pages 4-22 to 4-30) will be repeated. If you have other probes, refer to chapter 6, Probes and Accessories, page 6-1.

HELP!

==========

Use the number keys to enter the impulse threshold for this sensor. The acceptable range of impulse thresholds depends on the high voltage threshold that you have selected for this probe.

(Press HELP! again for information on how high voltage thresholds affect impulse thresholds if monitoring DC. Press HELP! twice for information on how high voltage thresholds affect impulse thresholds if monitoring AC).

==========

==========

This chart applies if you are monitoring DC:

High Voltage threshold	Acceptable impulse thresholds
1.0 - 7.0 Vdc	4 Vpk - 40 Vpk
7.1 - 17.0 Vdc	8 Vpk - 80 Vpk
17.1 - 99.9 Vdc	40 Vpk - 400 Vpk

==========

==========

If you are monitoring AC, this chart applies:

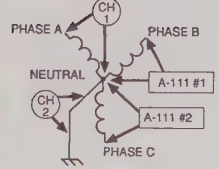
High Voltage threshold	Acceptable impulse threshold
1.0 - 15.0 Vrms	8 Vpk - 80 Vpk
15.1 - 130.0 Vrms	60 Vpk - 600 Vpk
130.1 - 260.0 Vrms	120 Vpk - 1200 Vpk
260.1 - 600.0 Vrms	240 Vpk - 2400 Vpk

(Press HELP! again for general information on the Setup Menu.)

==========

1. [illegible]
2. [illegible]
3. [illegible]
4. Three Phase Wye
5. DC or Custom [illegible]
6. Probes and [illegible]
7. [illegible]
8. Key Operation
9. Communication
10. [illegible]
11. Printing Paper
12. Troubleshooting
13. Specifications
14. Glossary
15. Recommended Thresholds
16. Index
17. Your Comments Please

4: Three-Phase Wye



The Report Menu lets you choose the graphs and summary reports your PowerScope prints. For a complete discussion of graphs and summary reports, see Appendix A.

Quick Guide to the Report Menu

1. Press the REPORT MENU key.

2. Use the VALUE UP/VALUE DOWN keys to answer the questions in the menu.

3. Press the down arrow to go to the next question.

4. Press the HELP! key if you want further explanation about the questions.

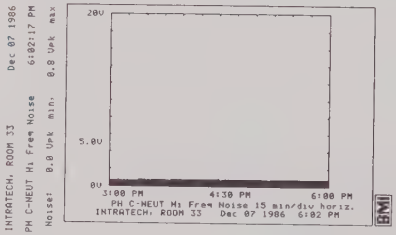
If you get the following message in the display, it's because the PowerScope has strip charts from the previous monitoring period.

Summary rpts: Print

Possible selections: Print
Clear

Use the VALUE UP/ VALUE DOWN keys to choose whether you want the pending strip charts.

If you want them printed then erased, position PRINT in the display, then press the down arrow.



This is a summary strip chart.

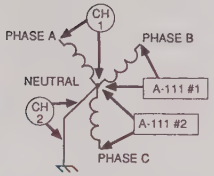
If you want them erased immediately, position CLEAR in the display, then press the down arrow.

Then, press the REPORT MENU key again and proceed.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select PRINT or CLEAR and then
use the DOWN ARROW key to enter
the menu you have selected.

If you select PRINT, the summary data
and strip charts that have been
gathered so far by the PowerScope will
be printed and then reset. If you
select CLEAR, all of the summary
data and strip charts will be reset
without printing.

If you don't want to lose any summary
data, you may return to the Monitor
mode by pressing the MONITOR key.

(There is no more HELP!)

====================================
```

4. Three-Phase Wye



Threshold report: On

Selections: On
Off

Use the VALUE UP/ VALUE DOWN key to turn the Threshold report on or off.

Your PowerScope prints the Threshold Report after you press the MONITOR key. The Threshold Report shows all the current settings. Generally, you should leave this report on.

```
====================================

BMI 2400 SITE                Jan 01 1988

THRESHOLD REPORT               12:37 AM

Type:      3-phase wye

PH A-NEUT THRESHOLDS (Channel 1)
      Surge voltage:  125.0 Vrms
      Sag voltage:    105.0 Vrms
      Impulse:          200 Vpk
      High freq noise: 10.0 Vpk
      High frequency:  61.2 Hz
      Low  frequency:  58.8 Hz
      Wave shape:       20% variation
      Minimum duration: 0.1 cycles
      Line impedance:    50 ohms
      Hysteresis:      1.0%

NEUT-GND THRESHOLDS (Channel 2)
      Surge voltage:    5.0 Vrms
      Impulse:          100 Vpk
      High freq noise: 10.0 Vpk
      Line impedance:    50 ohms
      Hysteresis:      1.0%

PH B-NEUT THRESHOLDS (Sensor A)
      Surge voltage:  125.0 Vrms
      Sag voltage:    105.0 Vrms
      Impulse:          100 Vpk

PH C-NEUT THRESHOLDS (Sensor B)
      Surge voltage:  125.0 Vrms
      Sag voltage:    105.0 Vrms
      Impulse:          100 Vpk

SUMMARY REPORT INTERVAL:  Off

Internal UPS time:   5 minutes.
```

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to turn the Threshold Report on or off. This report should normally be left on.

(Press HELP! again for more information on Threshold Reports).

==========
==========

The usual sequence for operating the PowerScope monitor is:

1) Press the SETUP MENU key and answer the questions. To go on to the next question, press the Down Arrow.

2) Connect the monitor to the power line. (See the HELP! message in the Setup Menu for the 'TYPE:' question.)

3) Press the MONITOR key to monitor the power line. Your reports will be printed automatically.

(Press HELP! again for general information on the six modes of operation.)

==========
==========

The PowerScope monitor can be in one of six modes:

1) Press the SETUP MENU key to program the Setup Menu. Use the up arrow and the down arrow key to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu. (You may want to press 'HELP!' when you have selected the type of power line you are going to monitor. This will give you installation instructions.)

   By pressing the SETUP MENU key, then immediately pressing the UP ARROW key, you will enter the Key Operator Menu. This menu will give you control of the detailed operation of the PowerScope.

2) Press the STATUS key to print the Status Report. This report tells you the present voltage, frequency, and noise on each of the channels. This report can be especially useful when you're trying to set the thresholds correctly. It's also useful for checking to see if you've installed the monitor correctly.

3) Press the REPORT MENU key to enter the Report menu. Use the up arrow and the down arrow to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu.

4) Press the MONITOR key to start monitoring the power line. The PowerScope will print a complete copy of your setup, and show you the initial waveshapes on each channel (if you have requested them in the Report Menu). Then it will print a disturbance report every time a power disturbance occurs.

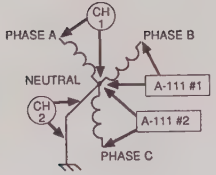
5) Press the CALIBRATION key to calibrate your PowerScope. To calibrate your PowerScope, you must connect an external A-016 Precision Calibrator to the PowerScope; If you haven't connected one, the PowerScope will print its most recent calibration data.

6) Press the SELF TEST key to test the PowerScope.

(There is no more HELP!)

==========

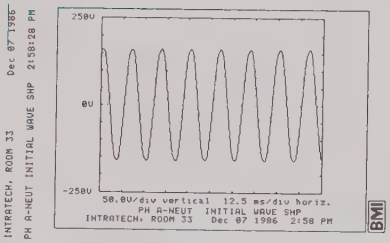
4. Three-Phase Wye



Initial waves: On

Selections: On
Off

Use the VALUE UP/ VALUE DOWN keys to turn the initial waveshape graphs on or off.



Your PowerScope prints initial waveshape graphs after the Threshold Report. These graphs show the initial condition of the sine waves. Generally you should leave this report on.

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to turn the Initial Waveshape Report on or off. This report should normally be left on.

(Press HELP! again for more information on the Initial Waveshape Report).

==========

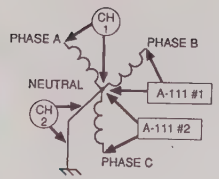
==========

The Initial Waveshape Report shows the condition of the sine waves at the beginning of the monitoring session. Initial waveshapes may give you additional information on the condition of the power lines.

(Press HELP! again for general information on the Report Menu).

==========

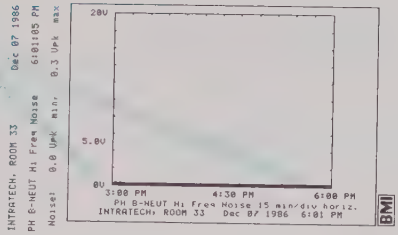
4 Three-Phase Wye



Strip charts: 3 Hr

Selections: 24Hr
12Hr
6Hr
3Hr
1Hr
Off

Use the VALUE UP/ VALUE DOWN keys to select the strip chart interval.



Phase A-to-neutral 3-hr strip chart.

```
-----------------------------------------
INTRATECH LABS                 May 11 1988

STRIP CHART REPORT                  6:00 PM
 From  3:00 PM  To  6:00 PM

A111 NO.1  (Channel 1)
 Rms:   119.2 Vrms min,  124.1 Vrms max
 Noise:   0.1 Vpk  min,    1.2 Vpk  max
 Freq:   60.0 Hz   min,   60.0 Hz   max
 Imp:       0 counted

A111 NO.2  (Channel 2)
 Rms:     0.7 Vrms min,    1.8 Vrms max
 Noise:   0.2 Vpk  min,    0.7 Vpk  max
 Imp:       0 counted

AMBIENT A (Sensor A)
 Tmp:      75 °F   min,     77 °F   max
          -4.5 °F /hr to     +4.0 °F /hr
 Hud:      45 %RH  min,     46 %RH  max
          -5.6 %RH/hr to     +4.6 %RH/hr
```

Strip chart summary report.

If you choose:

1 hr–strip charts will be printed every hour on the hour.
3 hr–strip charts will be printed every 3 hours beginning at 3:00.
6 hr–strip charts will be printed every 6 hours beginning at 6:00.
12 hr–strip charts will be printed every 12 hours beginning at 12:00.
24 hr–strip charts will be printed every 24 hours at midnight.
Off–no long-term summary information will be printed.

NOTE: Whatever strip chart interval you choose here will appear in the forthcoming questions.

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to select the time interval between printing strip charts and summary reports.

Possible selections are: 24 hours, 12 hours, 6 hours, 3 hours, 1 hour, or OFF. The interval that you choose impacts the choices offered you in the next series of questions.

(Press HELP! for more information on selecting strip chart summary reports).

==========

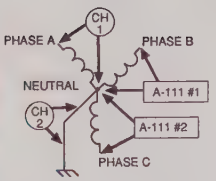
==========

If you choose, for example, 12-hour strip chart summaries, your choices in the next questions regarding individual strip chart summary reports will include 12-hour strip charts. (If you choose 3-hour strip charts here, your choices in the next questions will include 3-hour strip charts, and so on.)

(Press HELP! for general information on the Setup Menu.)

==========

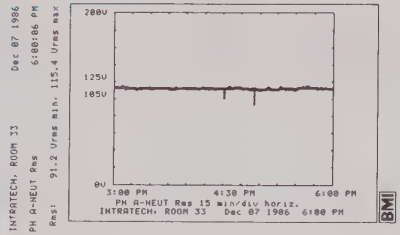
4. Three-Phase Wye



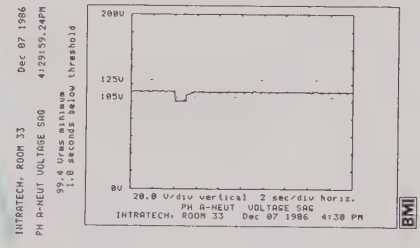
PH A-NEUT Rms: Both

Selections: Both
3 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the Rms signal on the phase A-to-neutral line.



3-Hr strip chart: phase A-to-neutral Rms.



Graph: phase A-to-neutral Rms disturbance.

If you choose:

3-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

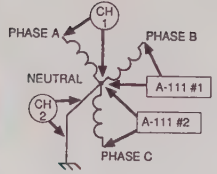
Both - your PowerScope will print both strip charts and graphs.

Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

=====================================
```

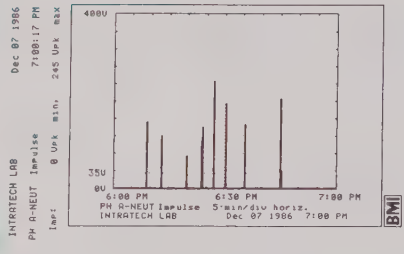
4. Three-Phase Wye



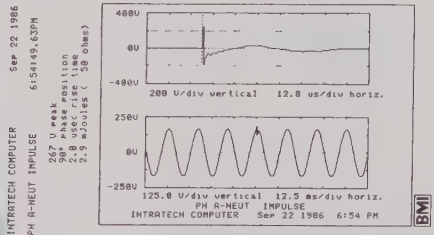
PH A-NEUT Imp: Both

Selections: Both
1-Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the report you'd like for this Line to neutral A Impulse.



1-Hr strip chart: phase A-to-neutral impulse.



Graph: phase A-to-neutral impulse.

If you choose:

1-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Both - your PowerScope will print both strip charts and graphs.

Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

=====================================
```

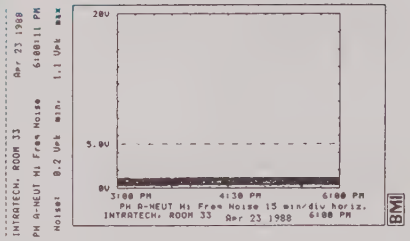

1. Single-phase
2. Dual-One-Phase
3. Dual-Two-Phase
4. Three-Phase Wye
5. [illegible]
6. [illegible]
7. If you have a [illegible]
8. Key Operator Menu
9. Communications Menu
10. [illegible]
11. Loading Paper
12. Troubleshooting
13. Specifications
A. [illegible]
B. Recommended Thresholds
[illegible]
Your Comments Please

4. Three-Phase Wye

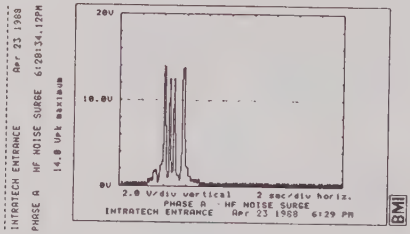
PH A-NEUT HFN: Both

Selections: Both
3 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for Phase A to Neutral HFN.



3-Hr strip chart: phase A to Neutral high-frequency noise.



Graph: phase A to Neutral high-frequency noise disturbance.

If you choose:

3-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

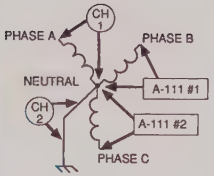
Both - your PowerScope will print both strip charts and graphs.

Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

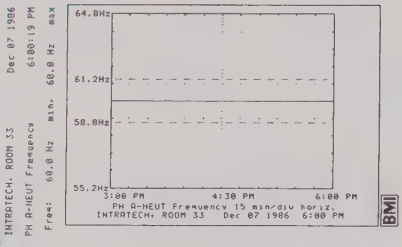

4. Three-Phase Wye



PH A-NEUT Freq.: Both

Selections: Both
3 Hr
Text
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the line-to-neutral A frequency signal.



3-Hr strip chart: phase A-to-neutral frequency.

```
INTRATECH, ROOM 33          Dec 07 1986
PH A-NEUT LOW FREQ.      6:44:14.08PM
     Frequency below:         58.8 Hz

-----------------------------------------
INTRATECH, ROOM 33          Dec 07 1986
PH A-NEUT LOW FREQ END   6:44:18.21PM
     Minimum frequency:       57.9Hz
```

Text report: phase A-to-neutral frequency.

If you choose:

Both - your PowerScope will print both strip charts and text reports.

3-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance text reports of this signal.

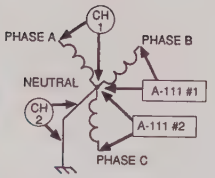
Text - your PowerScope will print disturbance text reports of this signal, but won't print strip charts.

Off - no disturbance text reports or strip charts will be printed for this signal; however the maximum reading of this signal will be reported textually in the summary reports.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a textual
     disturbance reports of this
     signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance reports.

TEXT -
     Your PowerScope will print a
     textual report of all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither textual reports nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu,
you will not have the choice of
strip chart summaries in this
question.

(Press HELP! again for general infor-
mation on the Report Menu.)

=====================================
```

4. Three-Phase Wye

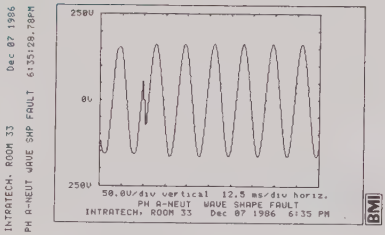


PH A-NEUT Wave: On

Selections: On
Off

Use the VALUE UP/ VALUE DOWN keys to turn line-to-neutral A waveshape fault graphs on or off.

Generally, these graphs should be left on.

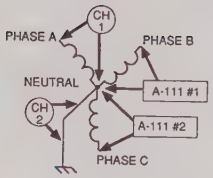


Phase A-to-neutral waveshape fault graph.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
turn on or off the Waveshape fault
disturbance reporting for this signal.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================

====================================

The Report Menu contains questions
that define the type of summary strip
charts you would like, and over what
time duration you would like them.

The questions in the Report Menu
vary depending on the type of power
each channel is monitoring, and if
you have probes plugged into the
environmental channels.

(Press HELP! again for general infor-
mation on the operating sequence.)

====================================
```

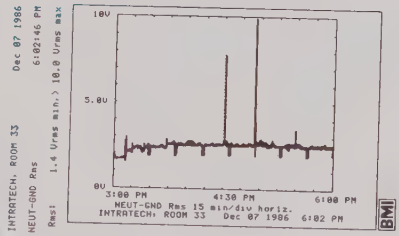

4. Three-Phase Wye



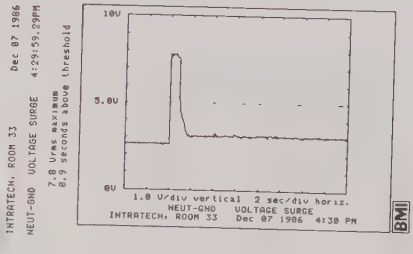
NEUT-GND Rms: Both

Selections: Both
3 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for Neutral to ground A impulses.



3-Hr strip chart: neutral-to-ground Rms.



Graph: neutral-to-ground Rms disturbance.

If you choose:

3-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

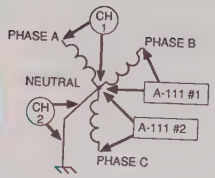
Both - your PowerScope will print both strip charts and graphs.

Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

=====================================
```

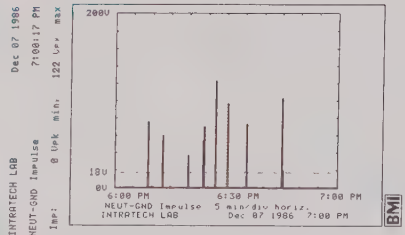
4. Three Phase Wye



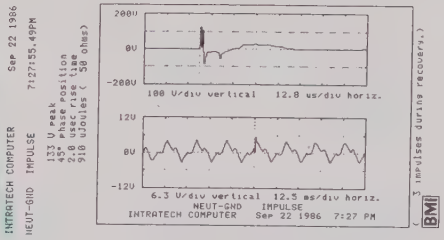
NEUT-GND Imp: Both

Selections: Both
1 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for Neutral to ground A impulses.



1-Hr strip chart: neutral-to-ground impulse.



Graph: neutral-to-ground impulse.

If you choose:

1-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

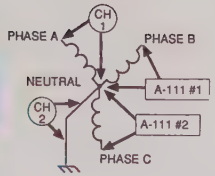
Both - your PowerScope will print both strip charts and graphs.

Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

=====================================
```

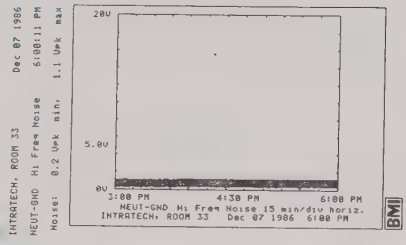
3. Three-Phase Delta



NEUT-GND HFN: Both

Selections: Both
3 Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for Neutral to ground HFN.



3-Hr strip chart: neutral-to-ground high-frequency noise.

If you choose:

3-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

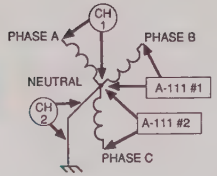
Both - your PowerScope will print both strip charts and graphs.

Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

=====================================
```

4. Three-Phase Wye



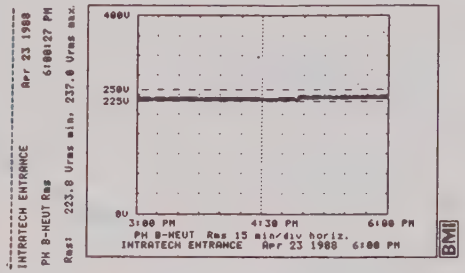
Using an A-111 AC/DC/Impulse Probe for phase B and C

NOTE: The following questions appear if you are using BMI A-111 AC/DC/Impulse probes to monitor phase B and C . The A-111s must be plugged into any of the "environmental" channels on the back of the 2400 PowerScope.

PH B-NEUT Rms: Both

Selections: Both
3 Hr
Text
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the voltage signal of the AC/DC/ Impulse Probe.



1-Hr strip chart: Rms.

```
INTRATECH LAB                    Apr 23 1988

PH B-NEUT VOLTAGE SURGE          4:44:44 PM
(Sensor A)

 Voltage above          125.0 Vrms
```

```
INTRATECH LAB                    Apr 23 1988

PH B-NEUT VOLT SURGE END         4:44:50 PM
(Sensor A)

 Maximum voltage:       132.8 Vrms
```

Text report: Rms.

If you choose:

Both - your PowerScope will print both strip charts and text reports.

3-Hr (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance text reports of this signal.

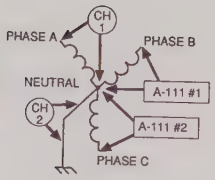
Text - your PowerScope will print disturbance text reports of this signal, but won't print strip charts.

Off - no disturbance text reports or strip charts will be printed for this signal; however the maximum reading of this signal will be reported textually in the summary reports.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a textual
     disturbance reports of this
     signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance reports.

TEXT -
     Your PowerScope will print a
     textual report of all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither textual reports nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu,
you will not have the choice of
strip chart summaries in this
question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

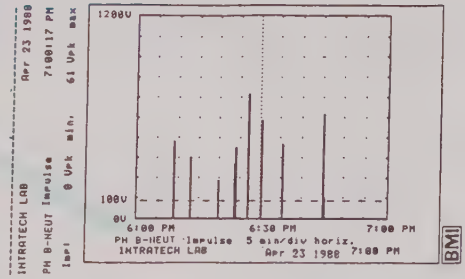
4. Three-Phase Wye



PH B-NEUT Imp: Both

Selections: Both
1 Hr
Text
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for Phase B to Neutral.



Impulse 1-Hr strip chart.

```
INTRATECH LAB                    Apr 23 1988
PH B-NEUT Impulse                4:45:29 PM
(Sensor 0)

Peak voltage:                    700 Vpk
```

Impulse text report.

If you choose:

Both - your PowerScope will print both strip charts and text reports.

1-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance text reports of this signal.

Text - your PowerScope will print disturbance text reports of this signal, but won't print strip charts.

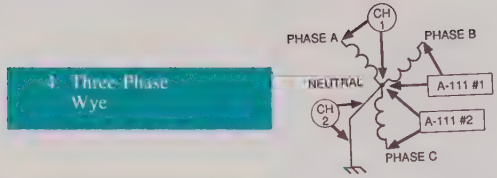
Off - no disturbance text reports or strip charts will be printed for this signal; however the maximum reading of this signal will be reported textually in the summary reports.

NOTE: If you are using a second A-111 AC/DC/Impulse Probe to monitor phase C-to-Neutral, then the same questions will be repeated. See pages 4-56 to 4-58 for details on these questions. If you have other probes connected, see chapter 6, Probes and Accessories, page 6-1.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a textual
     disturbance reports of this
     signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance reports.

TEXT -
     Your PowerScope will print a
     textual report of all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither textual reports nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu,
you will not have the choice of
strip chart summaries in this
question.

(Press HELP! again for general infor-
mation on the Report Menu.)

=====================================
```

4. Three-Phase Wye

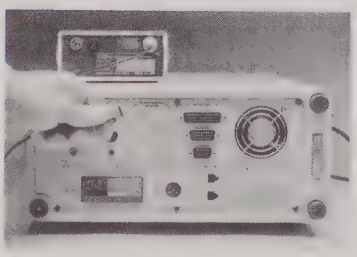


Part 3 discusses how to connect your PowerScope to monitor three-phase wye power.

Use BMI A-111 AC/DC/Impulse Probes for Phase B-to-Neutral, and C-to-Neutral.

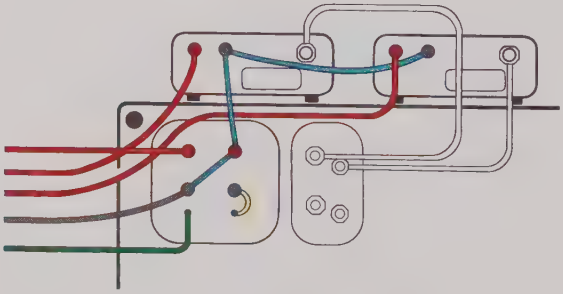
To monitor all lines of a 3-phase wye system (phase A, B, C and Neutral to Ground) requires four channels. Two of these channels are in the 2400 or 2600; you will need two BMI A-111 AC/DC/Impulse Probes to provide the other channels.

The A-111 AC/DC/Impulse Probe provides text reports and summary strip charts of disturbances, but does not produce the high-resolution graphics available from the PowerScope. Use your best judgement in deciding which two lines to monitor with the PowerScope, and which will use the A-111s. The following configuration uses the PowerScope's full resolution channels for phase A-to-Neutral, and Neutral-to-Ground. The A-111s are used for phase B-to-Neutral and phase C-to-Neutral.



WARNING
You are working with high voltages that cause burns and lethal shocks. Connect the safety earth ground first. USE STANDARD SAFETY PRECAUTIONS.

Use A-111 AC/DC/Impulse Probes for phase B and C.



Three phase wye connections.

Connecting to Three-PhaseWye

1. Using a green ground cable, connect the ground line to Channel 1 green (ground). Using a yellow jumper cable, connect Channel 2 ground to Channel 2 black (negative).

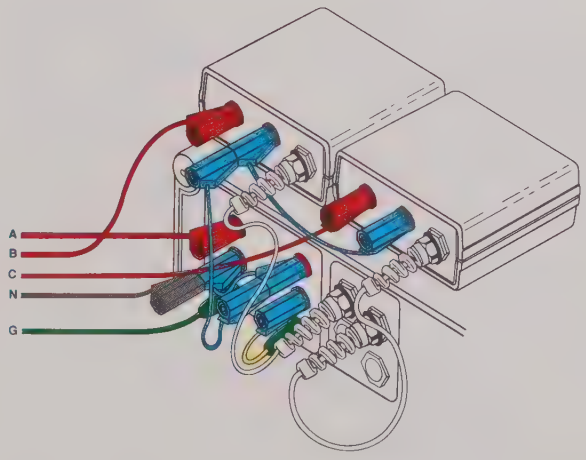
2. Using a red cable, connect line A to Channel 1 red (positive).

3. Using a black cable, connect neutral first to a blue jumper cable, then to Channel 1 black (negative). Connect the other end of the blue jumper cable to Channel 2 red (positive).

4. Using a blue jumber cable, connect Channel 2 red (positive) to the first A-111 black (negative). The Channel 2 red end of this jumper is piggy-backed onto the previous jumper.

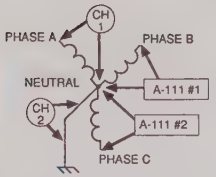
5. Using another blue jumper cable, connect the first A-111 black (negative) to the second A-111 black (negative), again piggy-backed.

6. Using a red cable, connect phase B to the first A-111 red (positive). Using another red cable, connect phase C to the second A-111 red (positive).



Three phase wye connections.

4. Three-Phase Wye



3-PHASE WYE:

Summary of Setup menu and Report menus. Menu prompts appear in the order shown. Scroll through the questions by pressing the Up Arrow or the Down Arrow. Answer the questions by pressing the VALUE UP/VALUE DOWN keys, and set the range values (in parenthesis) using the keypad.

Summary Reports: Print
Clear

Site: BMI 2400 SITE
(Any 15 character name)

Type: Single phase
Dual 1-phase
3-phase delta
-> 3-phase wye
Ind. Channels

Nom. Freq.: 60.0 Hz
(45-450)

Freq. Tol.: 1.2 Hz
(0.2-50%)

Surg. Volt: 125 Vrms
(1.0-750.0 Vrms)

Sag Volt: 105.0 Vrms
(0.0-749.9 Vrms)

Impulse thr: 200 Vpk
(400 Vpk-6400 Vpk)

[Imp. range: 400 Vpk]*
(±400-3200 Vpk)

Neut-Gnd: 5.0 Vrms
(0.1-99.9 Vrms)

N-G imp thr: 100 Vpk
(20-6400 Vpk)

[N-G imp range: 200Vpk]*
(±100-1600 Vpk)

Hi.freq.noise: 10.0 V
(1.0-19.9 V)

End of setup menu

If you are using BMI A-111 AC/DC/Impulse probes to monitor phase B-to-Neutral and phase C-to-Neutral, then the following questions will be automatically added to the Setup menu.

Sensor Setup: A
(A, B, C or D)

Name: PH B-NEUT
(Any 9 Characters)

Sensor Mode: Rms
(Rms or Vdc)

PH B-NEUT Hi 125.0Vrms
(1-600 Vrms or 1-99.9 Vdc)

PH B-NEUT Lo 105.0Vrms
(1-599.9 Vrms or 1-99.8 Vdc)

PH B-NEUT Imp.: 100.0Vpk
(10-2400 Vpk AC or 10-400V DC)

End of Setup menu.

* Appears only if Impulse ranging set to MANUAL in the Key Operator Menu.

REPORT MENU

Summary Reports: Print
Clear

Threshold report: On
Off

Initial Waves: On
Off

Strip charts: 24Hr
12Hr
6Hr
3Hr
1Hr
Off

PH A-NEUT Rms: Both
Strip chart interval
Graph
Off

PH A-NEUT Imp: Both
Strip chart interval
Graph
Off

PH A-NEUT HFN: Both
Strip chart interval
Graph
Off

PH A-NEUT Freq.: Both
Strip chart inteval
Text
Off

PH A-NEUT Wave: On
Off

NEUT-GND Rms: Both
Strip chart interval
Graph
Off

NEUT-GND Imp: Both
Strip chart interval
Graph
Off

NEUT-GND HFN: Both
Strip chart interval
Graph
Off

End of report menu.

If you are using BMI A-111 AC/DC/Impulse probes to monitor phase B-to-Neutral and phase C-to-Neutral, then the following questions will be automatically added to the Report menu.

PH B-NEUT Rms: Both
Strip chart interval
Graph
Off

PH B-NEUT Imp.: Both
Strip chart interval
Graph
Off

The same questions are repeated for PH C-NEUT.

End of report menu.

* Strip chart intervals may be selected at 1, 3, 6, 12 or 24 hours.

Chapter 5

DC or Custom Setups

This chapter describes how to set up the PowerScope for Independent Channels. This includes setup instructions for AC, DC and the BMI A-112 Current Probe. To illustrate the Setup and Report menus for Independent Channels, we have chosen the following configuration:

Channel 1 - AMPS, using the BMI A-112 Current Probe, page 5-8
Channel 2 - AC Neutral-to-Ground, page 5-18
Sensor A - Amps, using the BMI A-112 Current Probe, page 5-28
Sensor B - AC, using the BMI A-111 AC/DC/Impulse Probe, page 5-32
Sensor C - DC, using the BMI A-111 AC/DC/Impulse Probe, page 5-42

Quick Guide to the Setup Menu

1. Press the SETUP MENU key.

2. Use the VALUE UP/VALUE DOWN keys to answer the questions in the menu.

3. Press the down arrow key to go on to the next question.

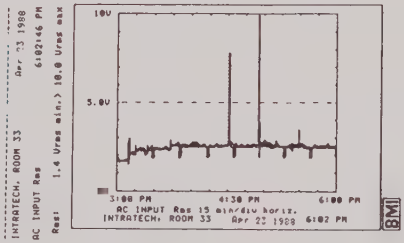
4. Press the HELP! key if you want further explanation about the question or on what to do next.

If you get the following message in the display, it's because the PowerScope has strip charts from a previous monitoring period.

Summary rpts: Print

Possible selections: Print
Clear

Use the VALUE UP/ VALUE DOWN keys to choose whether you want the pending strip charts.



Summary strip chart.

If you want them printed then erased, position PRINT in the display, then press the down arrow. If you want them erased immediately, position CLEAR in the display, then press the down arrow.

Then press SETUP MENU again and proceed.

HELP!

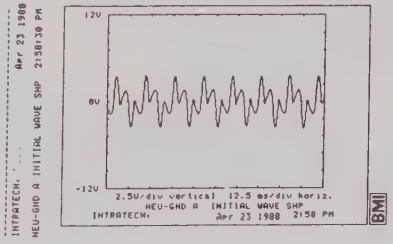
```
====================================

Use the VALUE UP/VALUE DOWN keys to
select PRINT or CLEAR and then
use the DOWN ARROW key to enter
the menu you have selected.

If you select PRINT, the summary data
and strip charts that have been
gathered so far by the PowerScope will
be printed and then reset. If you
select CLEAR, all of the summary
data and strip charts will be reset
without printing.

If you don't want to lose any summary
data, you may return to the Monitor
mode by pressing the MONITOR key.

(There is no more HELP!)

====================================
```

Site: INTRATECH

Use the number keys to enter the name of the site you are monitoring.

The name can be up to 20 characters long.

Use the left and right arrow keys to move the flashing cursor.



Use the number keys to enter both letters and numbers; for example, to enter the letter "K", press the 5JKL key 3 times. On the first press, a 5 will appear; on the second, a J will appear, and on the third, a K will appear.

Now move the flashing cursor to the next position by pressing the right arrow key. Press the 0 SPACE button twice to enter a space. Press the down arrow key to go on to the next question.

HELP!

==========

You may enter up to 20 characters from the keyboard to identify the site that you are monitoring.

Use the left and right arrow keys to move the flashing cursor.

Use the number keys to enter both letters and numbers. For example, to enter the letter 'B', push the '2ABC' key three times.

(Press HELP! again for general information on the Setup Menu.)

==========

The Setup Menu contains questions that define the operating parameters of your PowerScope. Specifically, it asks you to name the monitoring site, state what type of power each channel will monitor, and specify thresholds for each measurement.

The questions in the Setup Menu change automatically depending on what type of power you assign each channel and if you have probes plugged into the environmental channels.

(Press HELP! again for general information on the operating sequence.)

==========

The PowerScope monitor can be in one of six modes:

1) Press the SETUP MENU key to program the Setup Menu. Use the up arrow and the down arrow key to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu. (You may want to press 'HELP!' when you have selected the type of power line you are going to monitor. This will give you installation instructions.)

   By pressing the SETUP MENU key, then immediately pressing the UP ARROW key, you will enter the Key Operator Menu. This menu will give you control of the detailed operation of the PowerScope.

2) Press the STATUS key to print the Status Report. This report tells you the present voltage, frequency, and noise on each of the channels. This report can be especially useful when you're trying to set the thresholds correctly. It's also useful for checking to see if you've installed the monitor correctly.

3) Press the REPORT MENU key to enter the Report menu. Use the up arrow and the down arrow to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu.

4) Press the MONITOR key to start monitoring the power line. The PowerScope will print a complete copy of your setup, and show you the initial waveshapes on each channel (if you have requested them in the Report Menu). Then it will print a disturbance report every time a power disturbance occurs.

5) Press the CALIBRATION key to calibrate your PowerScope. To calibrate your PowerScope, you must connect an external A-016 Precision Calibrator to the PowerScope; If you haven't connected one, the PowerScope will print its most recent calibration data.

6) Press the SELF TEST key to test the PowerScope.

(There is no more HELP!)

==========

Three-Phase Wye
5. DC or Custom Setups

5. DC or Custom Setups

Type: Ind. channels

Selections: Single phase
Dual 1-phase
3 phase delta
3 phase wye
Ind. channels

Use the VALUE UP/VALUE DOWN keys to select independent channels.

Channel setup: 1

Selections: 1
2

Use the VALUE UP/VALUE DOWN keys to select which channel you will be setting thresholds for now.

HELP!

==========

Select 'Ind. channels' (Independent channels) if you want to setup each channel individually.

You will be asked to name each of the channels, and to specify what type of measurement each channel will be used for (AC, DC or NEUTRAL-GROUND). You will also assign separate monitoring thresholds for each of the channels.

(Press HELP! again for general information on the Setup Menu.)

==========

==========

Use the VALUE UP/VALUE DOWN keys to select which channel you will be setting thresholds for now.

(Press HELP! again for more information on answering this question).

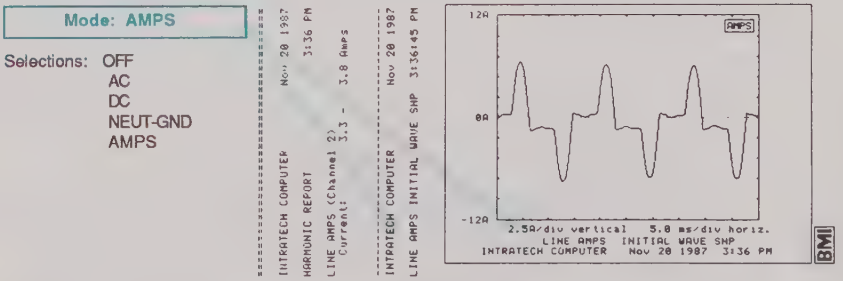
==========

IMPORTANT: A BMI A-112 Current Probe is required to monitor amperes. The A-112 Current Probe can be plugged into (1) an environmental channel, or (2) both a main and an environmental channel.

1. Environmental Channel. The A-112 has a gray lead which is plugged into the environmental sensor on the rear of the PowerScope. This connection alone will allow you to obtain strip charts and text reports.

2. Main Channel. The A-112 Current Probe may be connected to a main channel and an environmental channel simultaneously, using the red and black connector cables, and the gray lead. This enables you to obtain high resolution graphs of current impulses, surges, sags, and waveshape faults, as well as the text and strip chart reports. The gray sensor plug must also be used.

IF YOU ARE USING THE A-112 ONLY AS AN ENVIRONMENTAL SENSOR, THEN SKIP TO PAGE 5-28.



Use the VALUE UP/VALUE DOWN keys to select a mode for this channel. For this example, choose amps.

You have five choices:

OFF - Turns this channel off.

AC - Monitors AC voltages, to detect impulses, sags, surges, waveshape faults, noise, and frequency errors.

DC - Monitors DC voltages, to detect impulses, sags, surges, and noise (but will not monitor for frequency errors).

NEUT-GND - Monitors neutral-to-ground voltages, to detect impulses, surges, and noise (but not sags, frequency errors, or waveshape faults).

AMPS - Monitors current. *Requires a model A-112 Current Probe.*

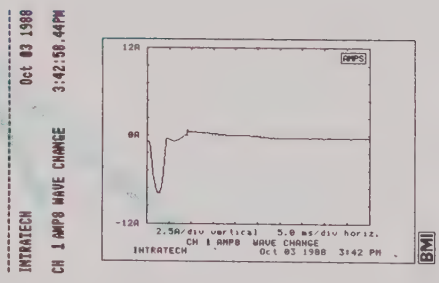
HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select a mode for this channel.

       You have five choices:

OFF -   Turns this channel off.

AC  -   Allows this channel to monitor
        AC voltages.  It will detect
        impulses, sags, surges,
        waveshape faults, noise, and
        frequency errors.

DC  -   Allows this channel to monitor
        DC voltages.  It will detect
        impulses, sags, surges, and
        noise (but will not monitor
        for frequency errors or
        waveshape faults).

NEUT/ - Allows this channel to monitor
GND     neutral-to-ground voltages. It
        will detect impulses, surges,
        and noise (but will not
        monitor for sags, frequency
        errors, or waveshape faults).

AMPS  - Allows this channel to monitor
        current. This requires a model
        A-112 Current Probe connected
        to the red and black safety
        connectors for this channel.
        It will detect impulses, sags,
        surges, and waveshape faults
        (but will not monitor for
        frequency errors or noise).

(Press HELP! again for general infor-
mation on the Setup Menu).

==================----================
```

Name: CH 1 AMPS

Use the number/letter keypad to name this channel.

The name can be up to 9 characters long. Let's say you want to name this channel CH 1 AMPS.



Use the left and right arrow keys to move the flashing cursor.
Use the number keys to enter both letters and numbers; for example, to enter the letter "C", press the 2ABC key 4 times. On the first press, a 2 will appear, on the second an A will appear, on the third a B will appear, and on the fourth a C will appear.

Now move the flashing cursor to the next position by pressing the right arrow key. Proceed in the same manner for the next letters. Press the 0 SPACE key button twice to enter a space. Press the down arrow key to go on to the next question.

HELP!

```
=====================================

You may enter up to 9 characters from
the keyboard to name this Current
probe.

Use the left and right arrow keys to
move the flashing cursor.  Use the
number keys to enter both letters and
numbers.  For example, to enter the
letter 'B', push the '2ABC' key three
times.  Then move the flashing cursor
to the next character.

(There is no more HELP!)

=====================================
```

5. DC or Custom Setups
6. Probes

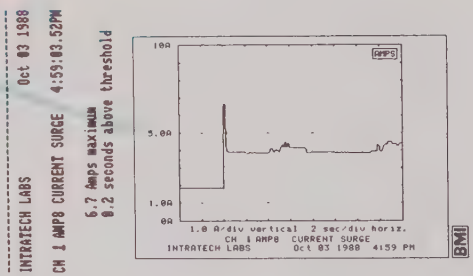
AMPS

Surge amps: 5.0 A_{rms}

Range: 1.0 A_{rms} to 600 A_{rms}

Use the number keys to enter the high-current threshold for this channel.

The usual value is about 10% above the nominal current level. The acceptable range is 1.0 A_{rms} to 600.0 A_{rms}.



Current surge graph.

The surge threshold also determines the full-scale RMS amperage as follows:

Current Surge Threshold Table

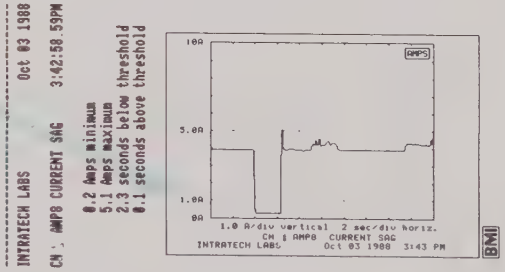
Surge Threshold	Full-Scale
1.0 - 6.2 Apk	10 Apk
6.3 - 12.5 Apk	20 Apk
12.6 - 25.0 Apk	40 Apk
25.1 - 62.5 Apk	100 Apk
62.6 - 125.0 Apk	200 Apk
125.1 - 166.5 Apk	250 Apk
166.6 - 250.0 Apk	400 Apk
250.1 - 600.0 Apk	800 Apk

Sag amps: 1.0 A_{rms}

Range: 0.0 A_{rms} to 599.0A_{rms}

Use the number keys to enter the low-current threshold.

The usual value is about 15% below the nominal current. The acceptable range is 0.0 to 599.0 A_{rms}.



Current sag graph.

HELP!

```
====================================

Use the number keys to enter the high
current threshold in Amps Rms.
The usual value is about 10% above
the nominal current.  The acceptable
range is 1.0 Arms to 600.0 Arms.

(Press HELP! again for general
information on the Setup Menu.)

====================================
```

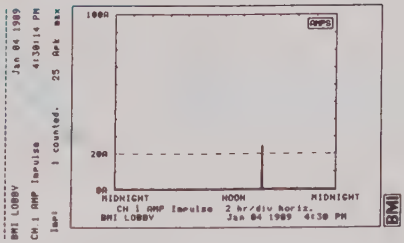
```
====================================

Use the number keys to enter the low
current threshold.  The usual value is
about 10% below the nominal current.
The acceptable range is 0.0 Arms to
599.9 Arms.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```

Impulse thr: 20 Apk

Range: 20 Apk to 1600 Apk

Use the number keys to enter the impulse threshold.

You may select any value from 20 Apk to 6400 Apk.



Impulse graph.

Note: The next question will only appear if you have Impulse Ranging in the Key Operator Menu set to MANUAL.

HELP!

```
=======================================

Use the number keys to enter the value
of the smallest impulse you wish the
PowerScope to report. Typical
thresholds are in the range of
100-250 amps.  You may select any
value from 20 to 6000 amps.

(Press HELP! again for more infor-
mation on answering this question.)

=======================================
```

```
=======================================

If you choose AUTO impulse ranging in
the Key Operator Menu, the PowerScope
will choose a full scale impulse range
according to the following table:

      Impulse                Impulse
    threshold              full scale
 ------------------      ----------
   20 Apk -   50 Apk        100 Apk
   51 Apk -  100 Apk        200 Apk
  101 Apk -  200 Apk        400 Apk
  201 Apk -  400 Apk        800 Apk
  401 Apk -  800 Apk       1600 Apk
  801 Apk - 1600 Apk       3200 Apk
 1601 Apk - 6000 Apk       6400 Apk

However, if you choose MANUAL impulse
ranging in the Key Operator Menu, you
will be asked to select a full scale
range yourself.

(Press HELP! again for general infor-
mation on the Setup Menu.)

=======================================
```

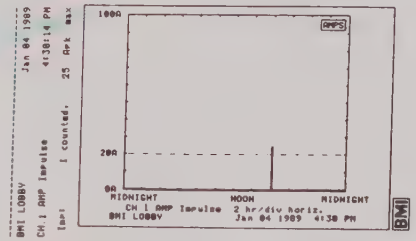
AMPS

NOTE: The next question will only appear if you have Impulse Ranging in the Key Operator Menu set to MANUAL.

Imp. range: 100 Apk

Possible selections: See the table below.

Use the VALUE UP/ VALUE DOWN keys to select the full-scale impulse range for this channel.



Impulse graph.

The selections depend on the impulse threshold. For example, a 20 to 50 amp threshold lets you have a choice of full-scale ranges, either ±100 or ±200 amps peak. Refer to the table that follows:

Manual Impulse Ranging Table

Impulse Threshold	Available Full-Scale Ranges
20-24 Apk	+/- 100 or 200 amps full-scale
25-49 Apk	+/- 100, 200 or 400 amps full-scale
50 Apk	+/- 100, 200, 400 or 800 amps full-scale
51-99 Apk	+/- 200, 400 or 800 amps full-scale
100 Apk	+/- 200, 400, 800 or 1600 amps full-scale
101-199 Apk	+/- 400, 800 or 1600 amps full-scale
200 Apk	+/- 400, 800 or 1600 amps full-scale
201-399 Apk	+/- 800 or 1600 amps full-scale
400 Apk	+/- 800, or 1600 amps full-scale
401-600 Apk	+/- 1600 amps full-scale
601-800 Apk	+/- 1600, 3200 or 6400 amps full-scale
801-1600 Apk	+/- 3200 or 6400 amps full-scale
1601-6400 Apk	+/- 6400 amps full-scale

If you selected AUTO Impulse Ranging in the Key Operator Menu (or plan to), the full-scale impulse range will be selected for you as follows:

Automatic Impulse Ranging Table

If Impulse Threshold selected in previous question is between...	The Impulse Range will set automatically to...
20 - 50 amps	+/- 100 amps
51 - 100 amps	+/- 200 amps
101 - 200 amps	+/- 400 amps
201 - 400 amps	+/- 800 amps
401 - 800 amps	+/- 1600 amps
801 - 1600 amps	+/- 3200 amps
1601- 6400 amps	+/- 6400 amps

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the full scale impulse range.
(If you want the PowerScope to choose
a range for you automatically, use the
Key Operator menu to select AUTO
impulse ranging.  The PowerScope will
automatically select a range that will
give you a good compromise between
resolution and dynamic range.)

(Press HELP! for more information on
selecting full scale ranges.)

====================================

====================================

The full scale impulse ranges are:

        100 Vpk
        200 Vpk
        400 Vpk
        800 Vpk
       1600 Vpk
       3200 Vpk
       6400 Vpk

To preserve resolution, the
PowerScope will not allow you to
select a full scale range that is
less than two times your impulse
threshold or greater than 16 times
your impulse threshold:

Full scale      Acceptable thresholds
----------      ---------------------
  100 Vpk          20 Vpk -    50 Vpk
  200 Vpk          20 Vpk -   100 Vpk
  400 Vpk          25 Vpk -   200 Vpk
  800 Vpk          50 Vpk -   400 Vpk
 1600 Vpk         100 Vpk -   800 Vpk
 3200 Vpk         200 Vpk -  1600 Vpk
 6400 Vpk         400 Vpk -  6400 Vpk

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```

Channel setup: 2

Selections: 1
2

Use the number/letter keypad to indicate which channel you will be setting thresholds for now.

We'll assume you will set thresholds for Channel 2 now.

HELP!

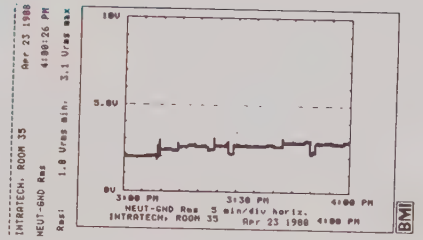
```
====================================

Use the VALUE UP/VALUE DOWN keys to
select which channel you will be
setting thresholds for now.

(Press HELP! again for more infor-
mation on answering this question).

====================================
```

NEUT-GND

Mode: NEUT-GND

Selections: OFF
AC
DC
NEUT-GND
AMPS

Use the VALUE UP/ VALUE DOWN keys to select a mode for Channel 2.



1-Hr strip chart, neutral-to-ground Rms.

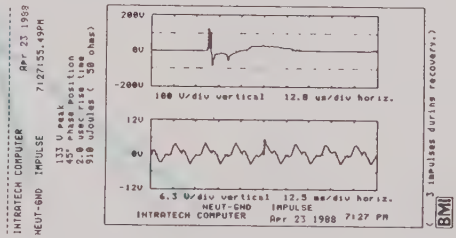
Let's assume that you want to monitor neutral-to-ground on this channel.

Name: NEUT GND

Use the number/letter keypad to name this channel.

The name can be up to 9 characters long. Let's say you want to name this channel NEUT-GND.

Use the left and right arrow keys to move the flashing cursor.



Disturbance graph: neutral-to-ground surge.

Use the number keys to enter both letters and numbers; for example, to enter the letter "G", press the 4GHI key 2 times. On the first press, a 4 will appear, on the second a G will appear.

Now move the flashing cursor to the next position by pressing the right arrow key. Press the 0 SPACE key button twice to enter a space. Press the down arrow key to go on to the next question.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select a mode for this channel.

       You have five choices:

OFF -   Turns this channel off.

AC  -   Allows this channel to monitor
        AC voltages.  It will detect
        impulses, sags, surges,
        waveshape faults, noise, and
        frequency errors.

DC  -   Allows this channel to monitor
        DC voltages.  It will detect
        impulses, sags, surges, and
        noise (but will not monitor
        for frequency errors or
        waveshape faults).

NEUT/ - Allows this channel to monitor
GND     neutral-to-ground voltages. It
        will detect impulses, surges,
        and noise (but will not
        monitor for sags, frequency
        errors, or waveshape faults).

AMPS  - Allows this channel to monitor
        current. This requires a model
        A-112 Current Probe connected
        to the red and black safety
        connectors for this channel.
        It will detect impulses, sags,
        surges, and waveshape faults
        (but will not monitor for
        frequency errors or noise).

(Press HELP! again for general infor-
mation on the Setup Menu).

====================================
```


5. DC or Custom

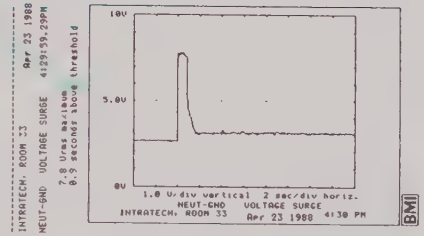
NEUT-GND

Surge volt: 5.0 Vrms

Range: 1.0 Vrms to 750 Vrms

Use the number keys to enter the high-voltage threshold.

The usual value is about 10% above the nominal voltage. The acceptable range is 1.0 Vrms to 750.0 Vrms. The surge voltage threshold also determines the full-scale RMS voltage as follows:



Neutral-to-ground surge graph.

Voltage Surge Threshold Table

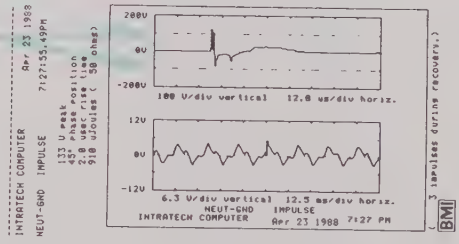
Surge Threshold	Full Scale
1.0 – 6.2 Vrms	10.0 Vrms
6.3 – 12.5 Vrms	20.0 Vrms
12.6 – 25.0 Vrms	40.0 Vrms
25.1 – 62.5 Vrms	100.0 Vrms
62.6 - 125.0 Vrms	200.0 Vrms
125.1 - 166.5 Vrms	250.0 Vrms
166.6 - 250.0 Vrms	400.0 Vrms
250.1 - 750.0 Vrms	800.0 Vrms

NEUT-GND

Range: 20 Vpk to 6000 Vpk

Use the number keypad to enter the impulse threshold.

Typical thresholds are from 50 to 250 volts. You may select any value from 20 to 6000 volts.



Neutral-to-ground impulse graph.

HELP!

```
====================================

Use the number keys to enter the
high voltage threshold.  The usual
value is about 10% above the nominal
voltage.  The acceptable range is
1.0 Vrms to 750.0 Vrms.

(Press HELP! again for general
information on the Setup Menu.)

====================================
```

```
====================================

Use the number keys to enter the
value of the smallest neutral-ground
impulse you wish the PowerScope to
report. Typical thresholds are in the
range of 50-250 volts.  You may
select any value from 20 to 6000
volts.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```

```
====================================

If you choose AUTO impulse ranging in
the Key Operator Menu, the PowerScope
will choose a full scale impulse range
according to the following table:

      Impulse                Impulse
    threshold              full scale
 ----------------          ----------
   20 Vpk -   50 Vpk          100 Vpk
   51 Vpk -  100 Vpk          200 Vpk
  101 Vpk -  200 Vpk          400 Vpk
  201 Vpk -  400 Vpk          800 Vpk
  401 Vpk -  800 Vpk         1600 Vpk
  801 Vpk - 1600 Vpk         3200 Vpk
 1601 Vpk - 6000 Vpk         6400 Vpk

However, if you choose MANUAL impulse
ranging in the Key Operator Menu, you
will be asked to select a full scale
range yourself.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```

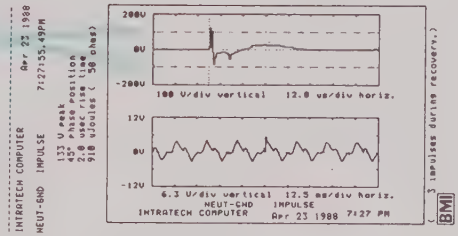
NEUT-GND

NOTE: You will only see this question if you have Impulse Ranging in the Key Operator Menu set to MANUAL.

Imp. range: 100 Vpk

Possible selections: See following table.

Use the VALUE UP/ VALUE DOWN keys to select the full-scale impulse range for neutral-to-ground..



Neutral-to-ground impulse graph.

The selections depend on the impulse threshold, e.g. for a 20-24 Vpk threshold, there are 2 full-scale ranges available, 100 or 200 volts full scale.

Manual Impulse Ranging Table

Impulse Threshold	Available Full-Scale Ranges
20-24 Vpk	+/-100 or 200 volts full-scale
24-49 Vpk	+/-100, 200 or 400 volts full-scale
50 Vpk	+/-100, 200, 400 or 800 volts full-scale
51-99 Vpk	+/-200, 400 or 800 volts full-scale
100 Vpk	+/-200, 400, 800 or 1600 volts full-scale
101-199 Vpk	+/-400, 800 or 1600 volts full-scale
200 Vpk	+/-400, 800, 1600 or 3200 volts full-scale
201-399 Vpk	+/-800, 1600 or 3200 volts full-scale
400 Vpk	+/-800, 1600, 3200 or 6400 volts full-scale
401-800 Vpk	+/-1600, 3200 or 6400 volts full-scale
801-1600 Vpk	+/-3200 or 6400 volts full-scale
1601-6400 Vpk	+/-6400 volts full-scale

If you selected AUTO Impulse Ranging in the Key Operator Menu (or plan to), the full-scale impulse range will be selected for you as follows:

Automatic Impulse Ranging Table

Impulse Threshold	Full-Scale Range Set Automatically To...
20 - 50 volts	+/- 100 volts
51 - 100 volts	+/- 200 volts
101 - 200 volts	+/- 400 volts
201 - 400 volts	+/- 800 volts
401 - 800 volts	+/- 1600 volts
801 - 1600 volts	+/- 3200 volts
1601- 6000 volts	+/- 6400 volts

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to select the full scale impulse range. (If you want the PowerScope to choose a range for you automatically, use the Key Operator menu to select AUTO impulse ranging. The PowerScope will automatically select a range that will give you a good compromise between resolution and dynamic range.)

(Press HELP! for more information on selecting full scale ranges.)

==========

==========

The full scale impulse ranges are:

100 Vpk
200 Vpk
400 Vpk
800 Vpk
1600 Vpk
3200 Vpk
6400 Vpk

To preserve resolution, the PowerScope will not allow you to select a full scale range that is less than two times your impulse threshold or greater than 16 times your impulse threshold:

Full scale	Acceptable thresholds
100 Vpk	20 Vpk - 50 Vpk
200 Vpk	20 Vpk - 100 Vpk
400 Vpk	20 Vpk - 200 Vpk
800 Vpk	50 Vpk - 400 Vpk
1600 Vpk	100 Vpk - 800 Vpk
3200 Vpk	200 Vpk - 1600 Vpk
6400 Vpk	400 Vpk - 6000 Vpk

(Press HELP! again for general information on the Setup Menu.)

==========

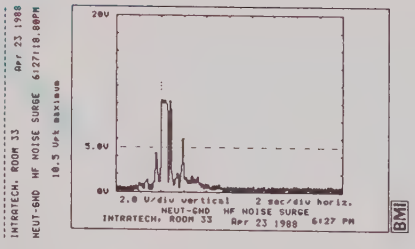
NEUT-GND

Hi- freq. noise: 5.0V

Range: 1.0V to 19.9V

Use the number keys to enter the high-frequency noise disturbance threshold (measured in peak-to-peak volts).

A typical threshold is 5.0 Vpk. The acceptable range is 1.0 Vpk to 19.9 Vpk.



Neutral-to-ground high-frequency noise disturbance graph.

HELP!

```
====================================

Use the number keys to enter the
high frequency noise disturbance
threshold (measured in peak-to-peak
volts).  A typical threshold is
5.0 Vpk.  The acceptable range is
1.0 Vpk to 19.9 Vpk.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```

The questions that follow will appear as part of the Setup menu when the A-112 Current Probe is also connected to Environmental Channel A.

Sensor A, AMPS

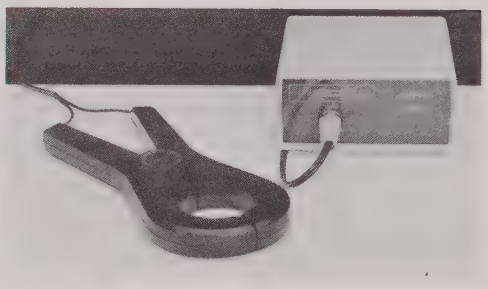
Sensor setup: A

Selections: A, B, C or D

Use the VALUE UP/ VALUE DOWN keys to select which probe you will be setting thresholds for now.

A-112 Current Probe

For the sake of example, let's say you have an AC/DC Impulse Probe plugged into sensor A. The sensor setup menu will automatically show sensor A.

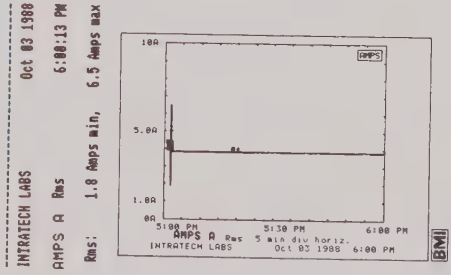


BMI Model A-112 Current Probe.

Name: AMPS A

Enter up to 9 characters from the keypad to name this probe.

The BMI A-112 Current Probe used here is named AMPS A. To change this name use the keypad.



For example, to enter a P, press the 7PQR key two times. On the first press, a 7 will appear, on the second press a P will appear. The third press would be a Q, and the fourth press an R. Press the right arrow key to advance the cursor. Press the 0 SPACE key twice to enter a space.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
choose which probe you will set
thresholds for now.  The choices you
have will depend on which environ-
mental channels you have probes
plugged into. The four environmental
channels are lettered A-D.

(Press HELP! again for general infor-
mation on the Setup Menu).

====================================
```

```
====================================

You may enter up to 9 characters from
the keyboard to name this Current
Probe.

Use the left and right arrow keys to
move the flashing cursor.  Use the
number keys to enter both letters and
numbers.  For example, to enter the
letter 'B', push the '2ABC' key three
times.  Then move the flashing cursor
to the next character.

(There is no more HELP!)

====================================
```

Sensor Mode: Off

Selections: On, Off

Use the VALUE UP/ VALUE DOWN keys to choose On or Off.

Default is Off. Since the main channel connection provides high-resolution graphs and text reports, there is no need to duplicate reports on the sensor channel.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the mode of this current probe.

     You have two choices:

Off -
     This should be selected when you
     are using the AMPS mode of
     independent channels.
     All data for the probe will be
     reported through the independent
     channel.

On -
     This should be selected when you
     do not want to dedicate one of
     your main channels to current
     measurements.

(Press HELP! again for general infor-
mation on the Setup Menu.)

=====================================
```

The questions that follow will appear as part of the Setup menu when the BMI A-111 AC/DC/Impulse Probe is connected to the PowerScope. For this setup, sensor channel B uses an A-111 to measure AC voltage on Line-to-Neutral.

Sensor setup: B

Selections: A, B, C or D

Use the VALUE UP/ VALUE DOWN keys to select which probe you will be setting thresholds for now.

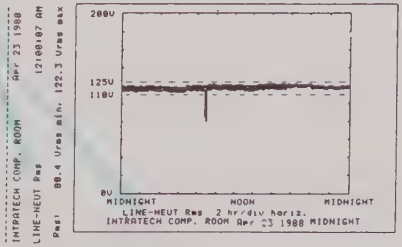
For the sake of example, let's say you have an AC/DC/ Impulse Probe plugged into Channel B. The Sensor setup menu will auto-matically show Channel B.

BMI Model A-111 AC/DC/Impulse probe.

Name: LINE NEUT

Enter up to 9 characters from the keypad to name this probe.

The BMI A-111 AC/DC/ Impulse Probe is here named LINE-NEUT. To change this name use the keypad.



Line-to-Neutral strip chart.

Use the number keys to enter both letters and numbers; for example, to enter the letter "K", pres the 5JKL key three times. On the first press a 5 will appear; on the second a J will appear; and on the third a K will appear. Now move the flashing cursor to the next position by pressing the right arrow key. Press the 0 SPACE button twice to enter a space. Press the down arrow key to go on to the next question.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
choose which probe you will set
thresholds for now.  The choices you
have will depend on which environ-
mental channels you have probes
plugged into. The four environmental
channels are lettered A-D.

(Press HELP! again for general infor-
mation on the Setup Menu).

=====================================
```

```
=====================================

You may enter up to 9 characters from
the keyboard to name this AC/DC
Voltage/Impulse probe.

Use the left and right arrow keys to
move the flashing cursor.  Use the
number keys to enter both letters and
numbers.  For example, to enter the
letter 'B', push the '2ABC' key three
times.  Then move the flashing cursor
to the next character.

(There is no more HELP!)

=====================================
```

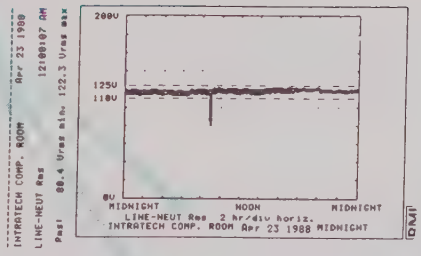

5. DC or Custom Setups

Probes and Accessories

Sensor Mode: Rms

Selections: Rms
Vdc

Use the VALUE UP/ VALUE DOWN keys to choose whether you will use this probe to monitor alternating or direct current.



This is a 1-Hr summary strip chart.

```
------------------------------------------
INTRATECH LAB                 Apr 23 1988
LNE-NEU B VOLTAGE SURGE       4:44:44 PM
(Sensor B)

 Voltage above          125.0 Vrms


------------------------------------------
INTRATECH LAB                 Apr 23 1988
LNE-NEU B VOLT SURGE END      4:44:50 PM
(Sensor B)

 Maximum voltage:       132.0 Vrms


------------------------------------------
```

This is a voltage disturbance text report.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the mode of this AC/DC/Impulse
probe.   Your choices are:

RMS  -  This should be selected for
        monitoring AC lines.
        It will make true
        RMS measurements.

VDC  -  This should be selected for
        monitoring batteries and
        DC supplies.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```

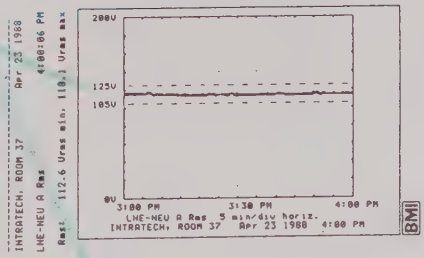
5. DC or Custom

LINE-NEUT high: 125.0Vrms

Selections: 1.0 to 600.0 Vrms
1.0 to 99.9 Vdc

Use the number keys to enter the high-voltage threshold for this probe.

The acceptable range is 1.0 to 600.0 Vrms, or 1.0 to 99.9 Vdc. Usually the threshold should be set to 10% above the nominal voltage. A typical value is 125.0 Vrms, or 5.5 Vdc.



Rms 1-Hr strip chart.

```
INTRATECH LAB                    Apr 23 1988
LNE-NEU B VOLTAGE SURGE          4:44:44 PM
(Sensor B)
 Voltage above          125.0 Vrms
```

```
INTRATECH LAB                    Apr 23 1988
LNE-NEU B VOLT SURGE END         4:44:50 PM
(Sensor B)
 Maximum voltage!       132.0 Vrms
```

Rms disturbance text report.

The full-scale range is determined by the high-voltage threshold as follows:

Rms Full-scale Range Table

High-voltage threshold	Full-scale range
1.0 - 15.0 Vrms	20.0 Vrms
15.1 - 130.0 Vrms	150.0 Vrms
130.1 - 260.0 Vrms	300.0 Vrms
160.1 - 600.0 Vrms	600.0 Vrms

Vdc Full-scale Range Table

High-voltage threshold	Full-scale range
1.0 - 6.0 Vdc	10.0 Vdc
6.1 - 16.0 Vdc	20.0 Vdc
16.1 - 99.9 Vdc	100.0 Vdc

HELP!

```
=====================================

Use the number keys to enter the high
voltage threshold for this probe.  The
usual value is about 10% above the
nominal voltage.  The acceptable range
is 1.0 Vrms to 600.0 Vrms.  A typical
value is 125.0 Vrms.

(Press HELP! again for information on
how threshold settings affect the
full scale range of this probe.)

=====================================
```

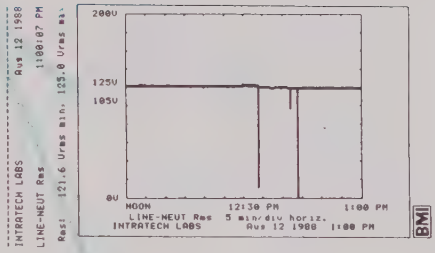
```
=====================================

The high voltage threshold that
you select will also determine the
full scale setting of this probe, as
follows:

   High Voltage        Full Scale
    threshold           setting
-----------------     ----------

  1.0 -  15.0 Vrms      20.0 Vrms
 15.1 - 130.0 Vrms     150.0 Vrms
130.1 - 260.0 Vrms     300.0 Vrms
260.1 - 600.0 Vrms     600.0 Vrms

(Press HELP! again for general infor-
mation on the Setup menu.)

=====================================
```

LINE-NEUT low 105.0Vrms

Selections: 0.0 to 599.9 Vrms
0.0 to 99.8 Vdc

Use the number keys to enter the low-voltage threshold for this probe.

The acceptable range is 0.0 to 599.9 Vrms, or 0.0 to 99.8 Vdc. Usually the setting should be made to 10% below the nominal voltage. A typical value is 105.0 Vrms, or 4.5 Vdc.



Rms 1-Hr strip chart.

```
INTRATECH LAB                    Apr 23 1988
LNE-NEU B VOLTAGE SAG            4:45:58 PM
(Sensor A)

 Voltage below          105.0 Vrms
```

```
INTRATECH LAB                    Apr 23 1988
LNE-NEU B VOLTAGE SAG END        4:45:58 PM
(Sensor A)

 Minimum voltage:       72.0 Vrms
```

Rms disturbance text report.

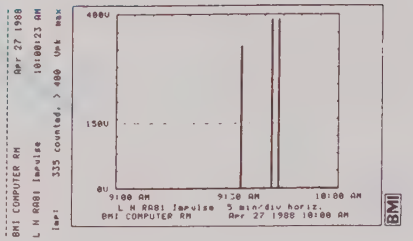
HELP!

```
=====================================

Use the number keys to enter the low
voltage threshold for this sensor. The
usual value is about 10% below the
nominal voltage.  The acceptable range
is 0.0 Vrms to 599.9 Vrms.   A typical
value is 105.0 Vrms.

(Press HELP! again for general infor-
mation on the Setup Menu.)

=====================================
```

LINE-NEUT Imp 150.0Vpk

Range: see table below.

Use the number keys to enter the impulse threshold.



Impulse 1-Hr strip chart

The acceptable impulse threshold settings for this probe depend on the high-voltage threshold you set in the previous question as follows:

```
----------------------------------------
INTRATECH LAB                Apr 23 1988

A111 NO.1 IMPULSE            4:45:29 PM
(Sensor B)

 Peak voltage:          780 Vpk
```

Impulse text report

AC Impulse Ranging Table

High Voltage Threshold AC	Full Scale Setting AC	Acceptable Impulse Threshold AC
1.0 - 15.0 Vrms	20.0 Vrms	8.0 - 80.0 Vpk
15.1 - 130.0 Vrms	150.0 Vrms	60.0 - 600 Vpk
130.1 - 260.0 Vrms	300.0 Vrms	120.0 - 1200 Vpk
260.1 - 600.0 Vrms	600.0 Vrms	240.0 - 2400 Vpk

DC Impulse Ranging Table

High Voltage Threshold DC	Full Scale Setting DC	Acceptable Impulse Threshold DC
1.0 - 7.0 Vdc	10.0 Vdc	4 - 40 Vpk
7.1 - 17.0 Vdc	20.0 Vdc	8 - 80 Vpk
17.1 - 99.9 Vdc	100.0 Vdc	40 - 400 Vpk

HELP!

Use the number keys to enter the impulse threshold for this sensor. The acceptable range of impulse thresholds depends on the high voltage threshold that you have selected for this probe.

(Press HELP! again for information on how high voltage thresholds affect impulse thresholds if monitoring DC. Press HELP! twice for information on how high voltage thresholds affect impulse thresholds if monitoring AC).

This chart applies if you are monitoring DC:

High Voltage threshold	Acceptable impulse thresholds
1.0 - 7.0 Vdc	4 Vpk - 40 Vpk
7.1 - 17.0 Vdc	8 Vpk - 80 Vpk
17.1 - 99.9 Vdc	40 Vpk - 400 Vpk

If you are monitoring AC, this chart applies:

High Voltage threshold	Acceptable impulse threshold
1.0 - 15.0 Vrms	8 Vpk - 80 Vpk
15.1 - 130.0 Vrms	60 Vpk - 600 Vpk
130.1 - 260.0 Vrms	120 Vpk - 1200 Vpk
260.1 - 600.0 Vrms	240 Vpk - 2400 Vpk

(Press HELP! again for general information on the Setup Menu.)

5. DC or Custom Setups

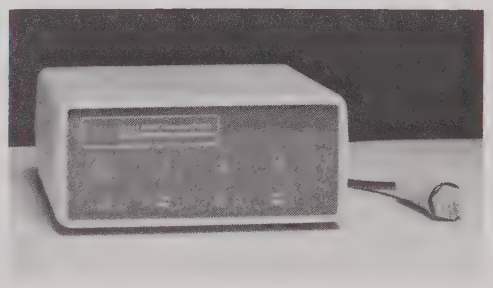
The questions that follow will appear as part of the Setup menu when the BMI A-111 AC/DC/Impulse Probe is connected to the PowerScope. Sensor channel C uses an A-111 to measure DC voltage.

Sensor setup: C

Selections: A, B, C or D

Use the VALUE UP/ VALUE DOWN keys to select which probe you will be setting thresholds for now.

For the sake of example, let's say you have an AC/DC Impulse Probe plugged into Channel C. The sensor setup menu will automatically show Channel C.

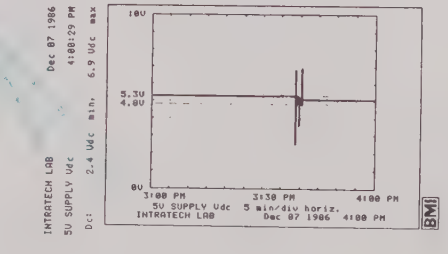


BMI Model A-111 AC/DC/Impulse probe.

Name: 5V SUPPLY

Enter up to 9 characters from the keypad to name this probe.

The BMI A-111 AC/DC Impulse Probe is here named DC SUPPLY. To change this name use the keypad.



1-Hr strip chart: Vdc.

Use the number keys to enter both letters and numbers; for example, to enter the letter 'K', press the '5JKL' key three times. On the first press a 5 will appear; on the second a J will appear; and on the third a K will appear. Now move the flashing cursor to the next position by pressing the right arrow key. Press the 0 SPACE button twice to enter a space. Press the down arrow key to go on to the next question.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
choose which probe you will set
thresholds for now.  The choices you
have will depend on which environ-
mental channels you have probes
plugged into. The four environmental
channels are lettered A-D.

(Press HELP! again for general infor-
mation on the Setup Menu).

====================================
```

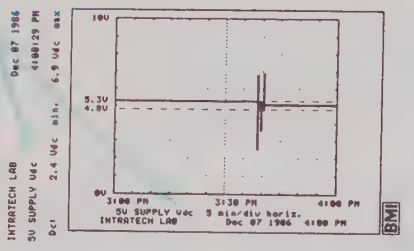
```
====================================

You may enter up to 9 characters from
the keyboard to name this AC/DC
Voltage/Impulse probe.

Use the left and right arrow keys to
move the flashing cursor.  Use the
number keys to enter both letters and
numbers.  For example, to enter the
letter 'B', push the '2ABC' key three
times.  Then move the flashing cursor
to the next character.

(There is no more HELP!)

====================================
```

Sensor Mode: Vdc

Selections: Rms, Vdc

Use the VALUE UP/ VALUE DOWN keys to choose whether you will use this probe to monitor alternating or direct current.

For this example we are using it to monitor DC voltage.



This is a 1-Hr summary strip chart.

```
INTRATECH LAB                    Dec 07 1986
ROOM 6    VOLTAGE SAG            4:45:38 PM
(Sensor B)
 Voltage below                   5.0 Vdc
```

```
INTRATECH LAB                    Dec 07 1986
ROOM 6    VOLTAGE SAG END        4:45:38 PM
(Sensor B)
 Minimum voltage:                2.8 Vdc
```

This is a voltage disturbance text report.

HELP!

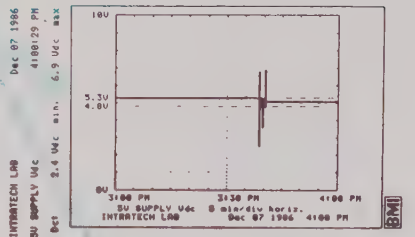
```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the mode of this AC/DC/Impulse
probe.   Your choices are:

RMS  -  This should be selected for
        monitoring AC lines.
        It will make true
        RMS measurements.

VDC  -  This should be selected for
        monitoring batteries and
        DC supplies.

(Press HELP! again for general infor-
mation on the Setup Menu.)

====================================
```

5V SUPPLY high: 5.3 Vdc

Selections: 1.0 to 600.0 Vrms
1.0 to 99.9 Vdc

Use the number keys to enter the high-voltage threshold for this probe.

The acceptable range is 1.0 to 600.0 Vrms, or 1.0 to 99.9 Vdc. Usually the threshold should be set to 10% above the nominal voltage. A typical value is 125.0 Vrms, or 5.5 Vdc.



Rms 1-Hr strip chart.

```
INTRATECH LAB                    Dec 07 1986
ROOM 6    VOLTAGE SURGE          4:44:44 PM
(Sensor B)
Voltage above            5.3 Vdc

-----------------------------------------
INTRATECH LAB                    Dec 07 1986
ROOM 6    VOLT SURGE END         4:44:50 PM
(Sensor B)
Maximum voltage:         9.0 Vdc
```

Rms disturbance text report.

The full-scale range is determined by the high-voltage threshold as follows:

Rms Full-scale Range Table

High-voltage threshold	Full-scale range
1.0 - 15.0 Vrms	20.0 Vrms
15.1 - 75.0 Vrms	150.0 Vrms
75.1 - 150.0 Vrms	300.0 Vrms
150.1 - 600.0 Vrms	600.0 Vrms

Vdc Full-scale Range Table

High-voltage threshold	Full-scale range
1.0 - 7.0 Vdc	10.0 Vdc
7.1 - 17.0 Vdc	20.0 Vdc
17.1 - 99.9 Vdc	100.0 Vdc

HELP!

==========

Use the number keys to enter the high voltage threshold for this sensor. The usual value is about 10% above the nominal voltage. The acceptable range is 1.0 Vdc to 99.9 Vdc. A typical value is 5.5 Vdc.

(Press HELP! again for information on how threshold settings affect the full scale range of this probe).

==========

==========

Use the number keys to enter the high voltage threshold for this sensor. The usual value is about 10% above the nominal voltage. The acceptable range is 1.0 Vdc to 99.9 Vdc. A typical value is 5.5 Vdc.

(Press HELP! again for information on how threshold settings affect the full scale range of this probe).

==========

==========

The threshold that you select will also determine the full scale reading of the probe, as follows:

High Voltage threshold	Full scale setting
1.0 Vdc - 7.0 Vdc	10.0 Vdc
7.1 Vdc - 17.0 Vdc	20.0 Vdc
17.1 Vdc - 99.9 Vdc	100.0 Vdc

(Press HELP! again for general information on the Setup menu).

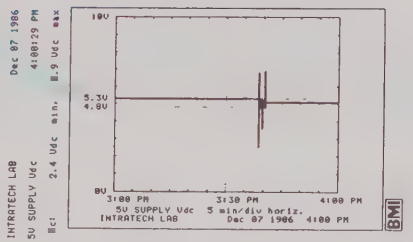
==========

5V SUPPLY low 4.8 Vdc

Selections: 0.0 to 599.9 Vrms
0.0 to 99.8 Vdc

Use the number keys to enter the low-voltage threshold for this probe.

The acceptable range is 0.0 to 599.9 Vrms, or 0.0 to 99.8 Vdc. Usually the setting should be made to 15% below the nominal voltage. A typical value is 105.0 Vrms, or 4.5 Vdc.



Vdc 1-Hr strip chart.

```
INTRATECH LAB                    Dec 07 1986

ROOM 6    VOLTAGE SAG            4:45:58 PM
(Sensor B)

 Voltage below                   5.0 Vdc


-------------------------------------------
INTRATECH LAB                    Dec 07 1986

ROOM 6    VOLTAGE SAG END        4:45:58 PM
(Sensor B)

 Minimum voltage!                2.0 Vdc
```

Vdc disturbance text report.

HELP!

```
=====================================

Use the number keys to enter the low
voltage threshold for this probe.  The
usual value is about 10% below the
nominal voltage.  The acceptable range
is 0.0 Vdc to 99.9 Vdc.  A typical
value is 4.5 Vdc.

(Press HELP! again for general infor-
mation on the Setup Menu).

=====================================
```

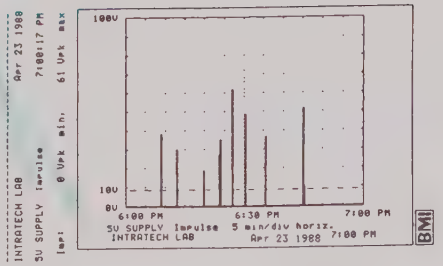
Sensor C, DC probe

5. DC or Custom Setups

5V SUPPLY Imp 10.0Vpk

Range: see table below.

Use the number keys to enter the impulse threshold.



Impulse 1-Hr strip chart

The acceptable impulse threshold settings for this probe depend on the high-voltage threshold you set in the previous question as follows:

```
INTRATECH LAB                    Apr 23 1988
ROOM 6    IMPULSE                4:45:29 PM
(Sensor B)
Peak voltage:                    80 Vpk
```

Impulse text report

AC Impulse Ranging Table

High Voltage Threshold AC	Full Scale Setting AC	Acceptable Impulse Threshold AC
1.0 - 15.0 Vrms	20.0 Vrms	8.0 - 80.0 Vpk
15.1 - 130.0 Vrms	150.0 Vrms	60.0 - 600 Vpk
130.1 - 260.0 Vrms	300.0 Vrms	120.0 - 1200 Vpk
260.1 - 600.0 Vrms	600.0 Vrms	240.0 - 2400 Vpk

DC Impulse Ranging Table

High Voltage Threshold DC	Full Scale Setting DC	Acceptable Impulse Threshold DC
1.0 - 7.0 Vdc	10.0 Vdc	4 - 40 Vpk
7.1 - 17.0 Vdc	20.0 Vdc	8 - 80 Vpk
17.1 - 99.9 Vdc	100.0 Vdc	40 - 400 Vpk

NOTE: If you have additional A-111 AC/DC/Impulse Probes plugged in, the Setup questions will be repeated. If you have different probes plugged in, refer to Chapter 6, Probes and Accessories, page 6-1.

HELP!

==========

Use the number keys to enter the impulse threshold for this sensor. The acceptable range of impulse thresholds depends on the high voltage threshold that you have selected for this probe.

(Press HELP! again for information on how high voltage thresholds affect impulse thresholds if monitoring DC. Press HELP! twice for information on how high voltage thresholds affect impulse thresholds if monitoring AC).

==========

==========

This chart applies if you are monitoring DC:

High Voltage threshold	Acceptable impulse thresholds
1.0 - 7.0 Vdc	4 Vpk - 40 Vpk
7.1 - 17.0 Vdc	8 Vpk - 80 Vpk
17.1 - 99.9 Vdc	40 Vpk - 400 Vpk

==========

==========

If you are monitoring AC, this chart applies:

High Voltage threshold	Acceptable impulse threshold
1.0 - 15.0 Vrms	8 Vpk - 80 Vpk
15.1 - 130.0 Vrms	60 Vpk - 600 Vpk
130.1 - 260.0 Vrms	120 Vpk - 1200 Vpk
260.1 - 600.0 Vrms	240 Vpk - 2400 Vpk

(Press HELP! again for general information on the Setup Menu.)

==========

The Report Menu lets you choose the graphs and summary reports your PowerScope prints. For a complete discussion of graphs and summary reports, see Appendix A.

Quick Guide to the Report Menu

1. Press the REPORT MENU key.

2. Use the VALUE UP/VALUE DOWN keys to answer the questions in the menu.

3. Press the down arrow to go to the next question.

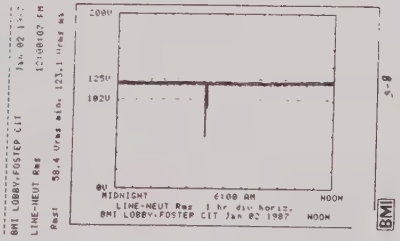
4. Press the HELP! key if you want further explanation about the questions.

If you get the following message in the display, it's because the PowerScope has strip charts from the previous monitoring period.

Summary rpts: Print

Possible selections: Print
Clear

Use the VALUE UP/ VALUE DOWN keys to choose whether you want the pending strip charts.



Summary strip chart.

If you want them printed then erased, position PRINT in the display, then press the down arrow. If you want them erased immediately, position CLEAR in the display, then press the down arrow.

Then press the REPORT MENU key again and proceed.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select PRINT or CLEAR and then
use the DOWN ARROW key to enter
the menu you have selected.

If you select PRINT, the summary data
and strip charts that have been
gathered so far by the PowerScope will
be printed and then reset. If you
select CLEAR, all of the summary
data and strip charts will be reset
without printing.

If you don't want to lose any summary
data, you may return to the Monitor
mode by pressing the MONITOR key.

(There is no more HELP!)

====================================
```

Threshold report: On

Selections: On
Off

Use the VALUE UP/ VALUE DOWN keys to turn the Threshold report on or off.

Your PowerScope prints the Threshold Report after you press the MONITOR key. The Threshold Report shows all the current settings. Generally, you should leave the Threshold report on.

```
=====================================

BMI 2460 SITE                Apr 10 1989

THRESHOLD REPORT                3:04 PM

Type:       Ind. channels

CH 1 AMPS THRESHOLDS (Channel 1)
      Mode:              AMPS
      Surge current:   125.0 Amps
      Sag current:     105.0 Amps
      Impulse:           200 Apk
      Wave shape:        20% variation
      Minimum duration: 0.1 cycles
      Line impedance:     50 ohms
      Hysteresis:       1.0%

NEUT-GND THRESHOLDS (Channel 2)
      Mode:            NEUT-GND
      Surge voltage:     5.0 Vrms
      Impulse:           100 Vpk
      High freq noise: 10.0 Vpk
      Line impedance:    50 ohms
      Hysteresis:       1.0%

AMPS A THRESHOLDS (Sensor A)
      Current sensor is off.

LINE NEUT THRESHOLDS (Sensor B)
      Surge voltage:   125.0 Vrms
      Sag voltage:     105.0 Vrms
      Impulse:           100 Vpk

5V SUPPLY THRESHOLDS (Sensor C)
      Surge voltage:     5.5 Vdc
      Sag voltage:       4.5 Vdc
      Impulse:             6 Vpk

SUMMARY REPORT INTERVAL: 24Hr

24 HOUR STRIP CHARTS
      CH 1 AMPS Rms Current
      CH 1 AMPS Impulse
      NEUT-GND Rms Voltage
      NEUT-GND Impulse
      LINE NEUT Rms Voltage
      LINE NEUT Impulse
      5V SUPPLY Dc Voltage
      5V SUPPLY Impulse

Internal UPS time:   5 minutes.
```

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to turn the Threshold Report on or off. This report should normally be left on.

(Press HELP! again for more information on Threshold Reports).

==========

==========

The Threshold Report is the list of thresholds and settings your PowerScope can print automatically before it begins monitoring.

(If you turn the Threshold Report on now, you can still omit it when you begin monitoring by pressing the MONITOR key followed immediately by the UP ARROW key.)

(Press HELP! again for general information on the Report Menu).

==========

==========

The Report Menu contains questions that define the type of summary strip charts you would like, and over what time duration you would like them.

The questions in the Report Menu vary depending on the type of power each channel is monitoring, and if you have probes plugged into the environmental channels.

(Press HELP! again for general information on the operating sequence.)

==========

==========

The Setup Menu contains questions that define the operating parameters of your PowerScope. Specifically, it asks you to name the monitoring site, state what type of power each channel will monitor, and specify thresholds for each measurement.

The questions in the Setup Menu change automatically depending on what type of power you assign each channel and if you have probes plugged into the environmental channels.

(Press HELP! again for general information on the operating sequence.)

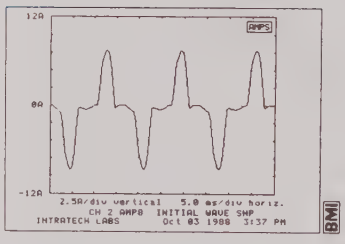
==========

Initial waves: On

Selections: On
Off

Use the VALUE UP/ VALUE DOWN keys to turn the initial waveshape graphs on or off.

INTRATECH LABS Oct 03 1988
CH 2 AMPS INITIAL WAVE SHP 3:37:57 PM



Your PowerScope prints initial waveshape graphs after the Threshold Report. These graphs show the initial condition of the sine waves. Generally, you should leave these graphs on.

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to turn the Initial Waveshape Report on or off. This report should normally be left on.

(Press HELP! again for more information on the Initial Waveshape Report).

==========

The Initial Waveshape Report shows the condition of the sine waves at the beginning of the monitoring session. Initial waveshapes may give you additional information on the condition of the power lines.

(Press HELP! again for general information on the Report Menu).

==========

The PowerScope monitor can be in one of six modes:

1) Press the SETUP MENU key to program the Setup Menu. Use the up arrow and the down arrow key to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu. (You may want to press 'HELP!' when you have selected the type of power line you are going to monitor. This will give you installation instructions.)

   By pressing the SETUP MENU key, then immediately pressing the UP ARROW key, you will enter the Key Operator Menu. This menu will give you control of the detailed operation of the PowerScope.

2) Press the STATUS key to print the Status Report. This report tells you the present voltage, frequency, and noise on each of the channels. This report can be especially useful when you're trying to set the thresholds correctly. It's also useful for checking to see if you've installed the monitor correctly.

3) Press the REPORT MENU key to enter the Report menu. Use the up arrow and the down arrow to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu.

4) Press the MONITOR key to start monitoring the power line. The PowerScope will print a complete copy of your setup, and show you the initial waveshapes on each channel (if you have requested them in the Report Menu). Then it will print a disturbance report every time a power disturbance occurs.

5) Press the CALIBRATION key to calibrate your PowerScope. To calibrate your PowerScope, you must connect an external A-016 Precision Calibrator to the PowerScope; If you haven't connected one, the PowerScope will print its most recent calibration data.

6) Press the SELF TEST key to test the PowerScope.

(There is no more HELP!)

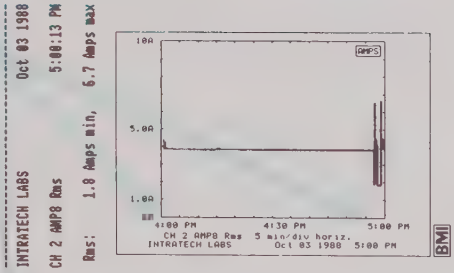
==========

5. DC or Custom Setups

Strip Chart: 1 Hr

Selections: 24 Hr
12 Hr
6 Hr
3 Hr
1 Hr
Off

Use the VALUE UP/ VALUE DOWN keys to select the strip chart interval.



1-Hr strip chart.

```
-----------------------------------
INTRATECH LABS              Oct 03 1988

STRIP CHART REPORT                5:00 PM
 From  4:00 PM  To  5:00 PM

CH 2 AMP8  (Channel 2)
 Rms:     1.8 Amps min,    6.7 Amps max
 Imp:       0 counted
```

Strip chart summary report.

If you select:

1 hr–strip charts will be printed every hour on the hour.
3 hr–strip charts will be printed every 3 hours beginning at 3:00.
6 hr–strip charts will be printed every 6 hours beginning at 6:00.
12 hr–strip charts will be printed every 12 hours beginning at 12:00.
24 hr–strip charts will be printed every 24 hours at midnight.
Off–no long-term summary information will be printed.

NOTE: Whatever strip chart interval you choose here will appear in the forthcoming questions.

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to select the time interval between printing strip charts and summary reports.

Possible selections are: 24 hours, 12 hours, 6 hours, 3 hours, 1 hour, or OFF. The interval that you choose impacts the choices offered you in the next series of questions.

(Press HELP! for more information on selecting strip chart summary reports).

==========

==========

If you choose, for example, 12-hour strip chart summaries, your choices in the next questions regarding individual strip chart summary reports will include 12-hour strip charts. (If you choose 3-hour strip charts here, your choices in the next questions will include 3-hour strip charts, and so on.)

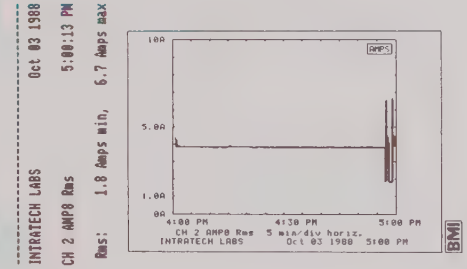
(Press HELP! for general information on the Setup Menu.)

==========

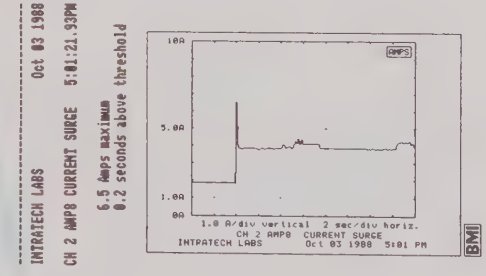
CH 1 AMPS Rms: Both

Selections: Both
1-Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the Rms signal on the AC line you are monitoring using Channel 1.



Rms 1-Hr strip chart.



Rms disturbance graph.

If you choose:

1-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Both - your PowerScope will print both strip charts and graphs.

Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

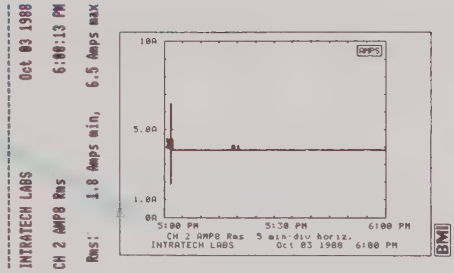
HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP? again for general infor-
mation on the Report Menu.)

====================================
```

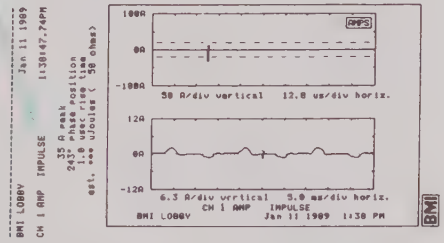
CH 1 AMPS Imp: Both

Selections: Both
1-Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for impulses.



Impulse 1-Hr strip chart.



Impulse disturbance graph.

If you choose:

1-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Both - your PowerScope will print both strip charts and graphs.

Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

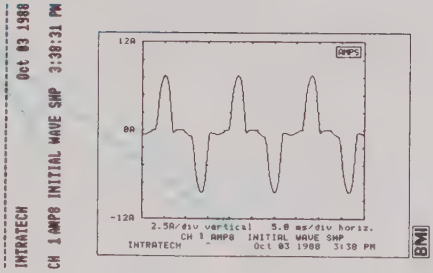
HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

CH 1 AMPS Wave: On

Selections: On
Off

Use the VALUE UP/ VALUE DOWN keys to turn waveshape fault graphs on or off.



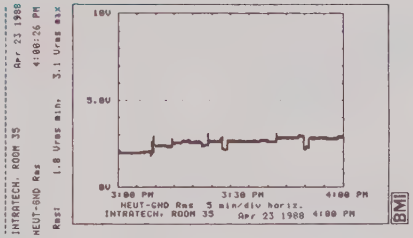
HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

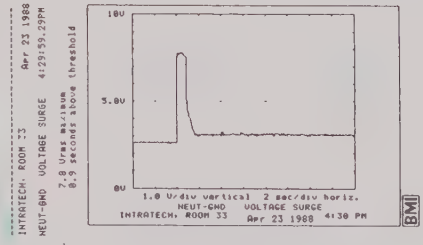
NEUT-GND Rms: Both

Selections: Both
1-Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the Rms signal on the neutral-to-ground line you are monitoring.



Neutral-to-ground Rms 1-Hr strip chart.



Neutral-to-ground surge graph.

If you choose:

1-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Both - your PowerScope will print both strip charts and graphs.

Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to select the report(s) you'd like for this signal.

You have four choices:

Both -
Your PowerScope will print both a strip chart summary and a disturbance graph of this signal.

Strip Chart Interval -
You will get only a strip chart summary of this signal, without disturbance graphs.

GRAPH -
Your PowerScope will graph all disturbances for this signal but will not print a strip chart for this signal.

OFF -
Your PowerScope will print neither disturbance graphs nor a strip chart, but the minimum and maximum readings of this signal will still be printed in the summary reports.

If you turned strip charts off at the beginning of the Report Menu, you will not have the choice of a strip chart summary in this question.

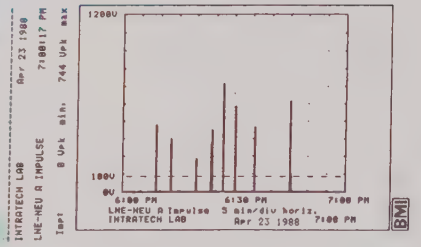
(Press HELP! again for general information on the Report Menu.)

==========

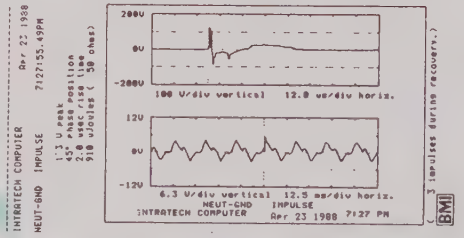
NEUT-GND Imp: Both

Selections: Both
1-Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for neutral-to-ground impulses.



Neutral-to-ground impulse 1-Hr strip chart.



Neutral-to-ground impulse disturbance graph.

If you choose:

1-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Both - your PowerScope will print both strip charts and graphs.

Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

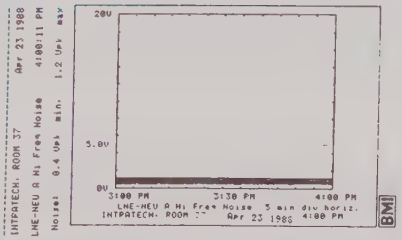
```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

=====================================
```


5. DC or Custom Setups
6. Probes and Accessories

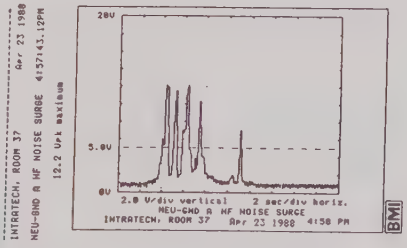
NEUT-GND HFN: Both

Selections: Both
1-Hr
Graph
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for the neutral-to-ground high-frequency noise signal.



Neutral-to-ground high-frequency noise 1-Hr strip chart.



Neutral-to-ground high-frequency noise disturbance graph.

If you choose:

1-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Graph - your PowerScope will print disturbance graphs of this signal, but won't print strip charts.

Both - your PowerScope will print both strip charts and graphs.

Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a
     disturbance graph of this signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance graphs.

GRAPH -
     Your PowerScope will graph all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither disturbance graphs nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu, you
will not have the choice of a strip
chart summary in this question.

(Press HELP! again for general infor-
mation on the Report Menu.)

=====================================
```

AMPS A Rms: Off

Selections: Both
1-Hr
Text
Off

Sensor A, Current probe

Use the VALUE UP/VALUE DOWN keys to select the reporting for the Current probe on the Environmental Sensor channel.

This Environmental Sensor report option is normally left off, since the Current Probe will produce high-resolution graphs from the main channel. If you choose Both, 1-Hr, or Text, these reports will be duplicates of reports from the main channel, Channel 1.

If you choose:

1-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance graphs.

Text - your PowerScope will print disturbance text reports of this signal, but won't print strip charts.

Both - your PowerScope will print both strip charts and graphs.

Off - no disturbance graphs or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you would like
for this probe.

     You have four choices:

BOTH -
     Your PowerScope will print both
     strip chart summaries and textual
     disturbance reports of this
     probe.

Strip Chart Interval -
     You will get only strip chart
     summaries of this probe.

TEXT -
     Your PowerScope will print
     textual disturbance reports of
     all disturbances for this probe
     but will not print strip charts
     for this probe.

OFF -
     Your PowerScope will print
     neither textual reports nor strip
     charts, but the minimum and
     maximum readings of this probe
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu,
you will not have the choice of
strip chart summaries in this
question.

(Press HELP! again for general infor-
mation on the Report Menu.)

=====================================
```

5. DC or Custom Setups

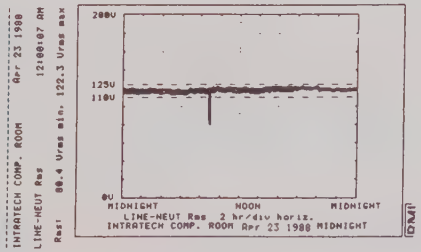
NOTE: The following report questions assume you are using sensor channel B for AC and sensor channel C for DC.

Sensor B, AC probe

LINE NEUT Rms: Both

Selections: Both
1-Hr
Text
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for AC voltage.



Line-to-Neutral rms 1-hr strip chart.

```
INTRATECH LAB                    Apr 23 1988
LNE-NEU B VOLTAGE SAG            4:45:50 PM
(Sensor B)

 Voltage below          105.0 Vrms
```

```
INTRATECH LAB                    Apr 23 1988
LNE-NEU B VOLTAGE SAG END        4:45:50 PM
(Sensor B)

 Minimum voltage:       72.0 Vrms
```

Line -to-Neutral text report.

If you choose:

1-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance text reports.

Text - your PowerScope will print disturbance text reports of this signal, but won't print strip charts.

Both - your PowerScope will print both strip charts and text reports.

Off - no text reports or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

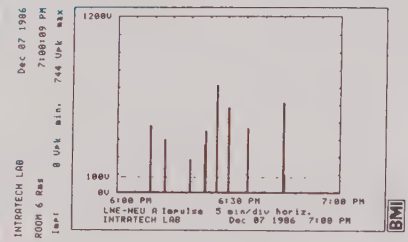
```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a textual
     disturbance reports of this
     signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance reports.

TEXT -
     Your PowerScope will print a
     textual report of all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither textual reports nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu,
you will not have the choice of
strip chart summaries in this
question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

Sensor B, AC probe

LINE NEUT Imp: Both

Selections: Both
1-Hr
Text
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for impulses.



Line-to-Neutral impulse 1-Hr strip chart.

```
------------------------------------
INTRATECH LAB                Apr 23 1988

ROOM 6    IMPULSE            4:45:29 PM
(Sensor B)

 Peak voltage:               780 Vpk
```

Impulse text report.

If you choose:

1-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance text reports.

Text - your PowerScope will print disturbance text reports of this signal, but won't print strip charts.

Both - your PowerScope will print both strip charts and text reports.

Off - no text reports or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

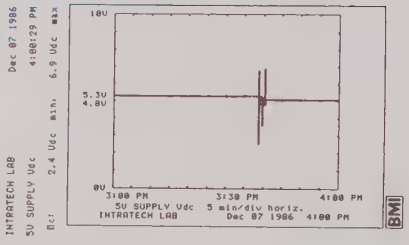
```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a textual
     disturbance reports of this
     signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance reports.

TEXT -
     Your PowerScope will print a
     textual report of all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither textual reports nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu,
you will not have the choice of
strip chart summaries in this
question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

Sensor C, DC probe

5V SUPPLY Vdc: Both

Selections: Both
1-Hr
Text
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for DC voltage.



Vdc 1-hr strip chart

```
----------------------------------------
INTRATECH LAB                 Apr 23 1988

5V SUPPLY VOLTAGE BAG         4:45:58 PM
(Sensor C)

 Voltage below          5.0 Vdc
```

```
----------------------------------------
INTRATECH LAB                 Apr 23 1988

5V SUPPLY VOLTAGE BAG END     4:45:58 PM
(Sensor C)

 Minimum voltage!           2.0 Vdc
```

DC text report

If you choose:

1-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance text reports.

Text - your PowerScope will print disturbance text reports of this signal, but won't print strip charts.

Both - your PowerScope will print both strip charts and text reports.

Off - no text reports or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

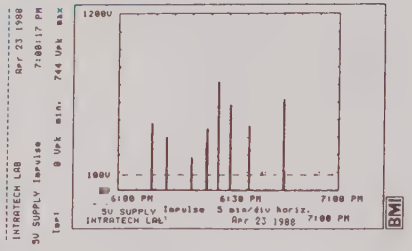
```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a textual
     disturbance reports of this
     signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance reports.

TEXT -
     Your PowerScope will print a
     textual report of all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither textual reports nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu,
you will not have the choice of
strip chart summaries in this
question.

(Press HELP! again for general infor-
mation on the Report Menu.)

====================================
```

Sensor C, DC probe

5V SUPPLY Imp: Both

Selections: Both
1-Hr
Text
Off

Use the VALUE UP/ VALUE DOWN keys to select the reporting for impulses.



DC impulse 1-Hr strip chart.

```
INTRATECH LAB                    Apr 23 1988

5V SUPPLY IMPULSE                4:45:29 PM
(Sensor B)

 Peak voltage:                   788 Vpk
```

DC impulse text report.

If you choose:

1-Hr - (1, 3, 6, 12, or 24 hours) - your PowerScope will print strip charts of this signal, but won't print disturbance text reports.

Text - your PowerScope will print disturbance text reports of this signal, but won't print strip charts.

Both - your PowerScope will print both strip charts and text reports.

Off - no text reports or strip charts will be printed for this signal; however the minimum and maximum readings of this signal will be reported textually in the summary reports.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the report(s) you'd like for
this signal.

     You have four choices:

Both -
     Your PowerScope will print both a
     strip chart summary and a textual
     disturbance reports of this
     signal.

Strip Chart Interval -
     You will get only a strip chart
     summary of this signal, without
     disturbance reports.

TEXT -
     Your PowerScope will print a
     textual report of all
     disturbances for this signal but
     will not print a strip chart for
     this signal.

OFF -
     Your PowerScope will print
     neither textual reports nor a
     strip chart, but the minimum and
     maximum readings of this signal
     will still be printed in the
     summary reports.

If you turned strip charts off at
the beginning of the Report Menu,
you will not have the choice of
strip chart summaries in this
question.

(Press HELP! again for general infor-
mation on the Report Menu.)

=====================================
```


7. Single-phase
8. Three-Wire Delta
9. Three-Phase Wye
5. DC or Custom Setups
6. Probes and Accessories
Your Menu [illegible] Card
Data Collection Basics
Communications Menu
Operation
11. Loading Paper
12. Troubleshooting
13. Specifications
A. Glossary
B. Recommended Thresholds
Index
Your Comments Please

WARNING
You are working with high voltages that cause burns and lethal shocks. Connect the safety earth ground first. USE STANDARD SAFETY PRECAUTIONS.

To connect to AC power using independent channels, refer to the connection instructions for the particular power type you want to monitor.

For Single-Phase power, see page 1-44.
For Dual One-Phase power, see page 2-60.
For Three-Phase Delta power, see page 3-50.
For Three-Phase Wye power, see page 4-60.

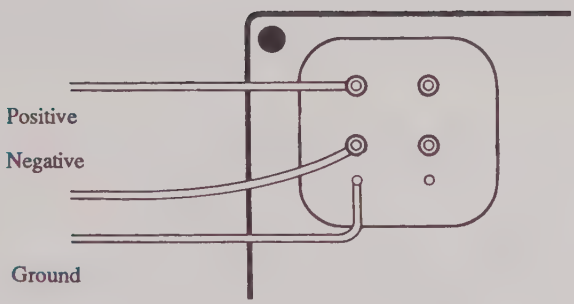
For DC see the following page, DC.
For amps, see the following page, AMPS.

Press the STATUS key to get a printout verifying that you've connected correctly, and that your initial readings are within the thresholds you've set.

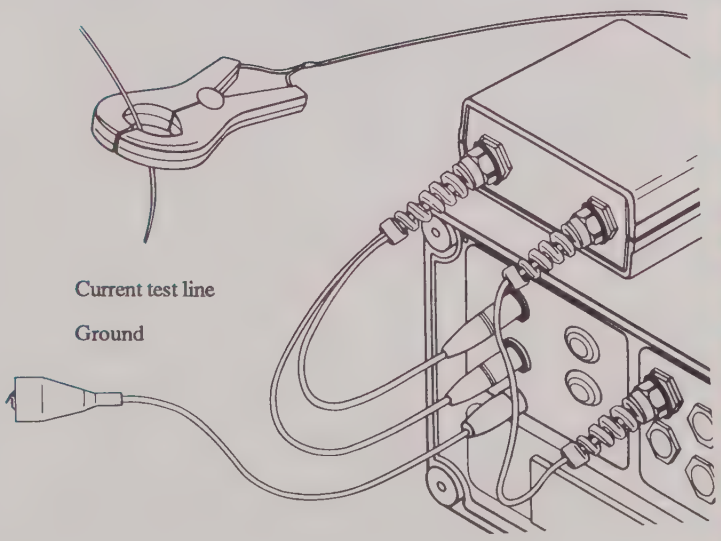
Press the MONITOR key to begin monitoring.

```
=====================================

BMI 2460 SITE              Apr 10 1989

STATUS REPORT                  3:34 PM

CH 1 AMPS (Channel 1)
   Current:       5.0 -   5.0 Amps

NEUT-GND (Channel 2)
   Voltage:        1.3 -   3.2 Vrms
   Hi freq noise:  0.2 -   0.2 Vpk

AMPS A (Sensor A)
   Current sensor is off.

LINE NEUT (Sensor B)
   Voltage:      119.8 - 120.3 Vrms
   Impulse:        110 -   120 Vpk

5V SUPPLY (Sensor C)
   Voltage:        4.5 -   5.5 Vdc
   Impulse:       19.8 -  20.0 Vpk

BATTERY CONDITION
   Voltage:    11.6 Vdc
   State:       Charged

=====================================
```

DC Connections



AMPS Connections (A-112)



Part 3: Connecting to Independent Channels

WARNING
You are working with high voltages that cause burns and lethal shocks. Connect the safety earth ground first. USE STANDARD SAFETY PRECAUTIONS.

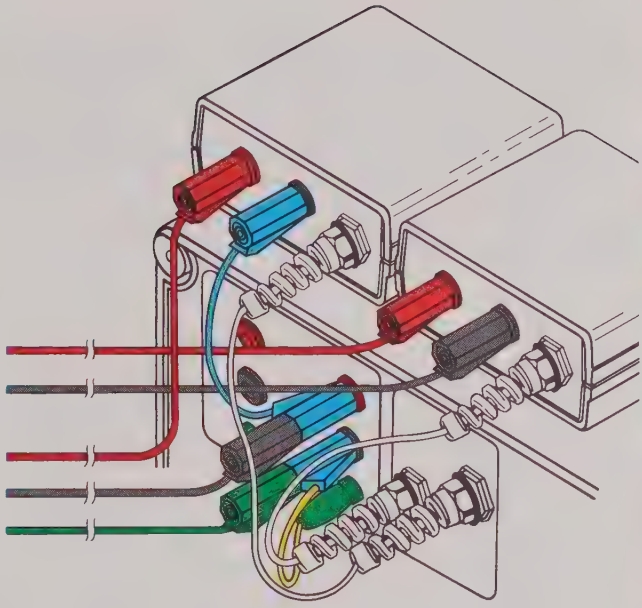
The following diagram illustrates how to set up the PowerScope for Independent Channels, as described in the text. For your review, the text describes the following configuration:

Channel 1 - AMPS, using the BMI A-112 Current Probe, page 5-8
Channel 2 - AC Neutral-to-Ground, page 5-18
Sensor A - Amps, using the BMI A-112 Current Probe, page 5-28
Sensor B - AC, using the BMI A-111 AC/DC/Impulse Probe, page 5-32
Sensor C - DC, using the BMI A-111 AC/DC/Impulse Probe, page 5-42

The diagram on page 5-83 shows how to connect a BMI A-112 Current Probe to Channel 1. For simplicity, the diagram on page 5-85 excludes the Current Probe connections, and shows only connections for AC neutral-to-ground for Channel 2, and BMI A-111 AC/DC/Impulse Probes for AC line-to-neutral (Sensor B), and DC (Sensor C).

Press the STATUS key to get a printout verifying that you've connected correctly, and that your initial readings are within the thresholds you've set.

Press the MONITOR key to begin monitoring.



Connections for AC neutral-to-ground for Channel 2, and BMI A-111 AC/DC/Impulse Probes for AC line-to-neutral (Sensor B), and DC (Sensor C).

INDEPENDENT CHANNELS

Summary of Setup menu and Report menus. Scroll through questions by pressing the Up Arrow or the Down Arrow. Choose options by pressing the VALUE UP/VALUE DOWN keys, and use the keypad to change range values (in parentheses).

Many different configurations are possible with Independent Channels. To illustrate the Setup and Report menus we have chosen the following configuration:
Channel 1 - AMPS, using the BMI A-112 Current Probe
Channel 2 - AC Neutral-to-Ground
Sensor A - Amps, using the BMI A-112 Current Probe
Sensor B - AC, using the BMI A-111 AC/DC/Impulse Probe
Sensor C - DC, using the BMI A-111 AC/DC/Impulse Probe

Summary Reports: Print
Clear

Site: BMI 2400 SITE (Any 15 characters)

Type: Single phase
Dual 1-phase
3-phase delta
3-phase wye
-> Ind. channels

Channel setup: 1 (2)

Mode: AMPS
(AC, DC, NEUT-GND, AMPS, OFF)

Name: CH 1 AMPS (Any 9 characters)

Surge amps: 5.0 Arms
(1.0 to 750.0 Arms)

Sag amps: 1.0 Arms
(0.0-749.9 Arms)

Impulse thr: 20 Apk
(20Apk-6400 Apk)

[Imp. range: 200 Apk]*
(±100-200 Apk)

Channel setup: 2 (1)

Mode: NEUT-GND
(AC, DC, NEUT-GND, AMPS, OFF)

Name: NEUT-GND (Any 15 characters)

Surge volt: 5.0 Vrms
(1.0 to 750.0 Vrms)

Impulse thr: 50 Vpk (20-6400 Vpk)

[Imp. range: 400 Vpk]*
(±100-800 Vpk)

Hi.Freq.Noise: 5.0 V
(1.0 V to 19.9 V)

Sensor Setup: A (With A-112 Probe)

Name: AMPS A (Any 9 characters)

Sensor mode: Off (On)

Sensor Setup: B (With A-111 Probe)

Name: LINE NEUT (Any 9 characters)

Sensor Mode: Rms (Vdc)

LINE NEUT hi: 125.0 Vrms
(1 to 600 Vrms or 1 to 99.9 Vdc)

LINE NEUT low: 105.0 Vrms
(0 to 599.9 Vrms or 0 to 99.8 Vdc)

LINE NEUT Imp. 100 Vpk
(10 to 2400 Vpk or 10 to 400 Vpk DC)

(Sensor C, used for DC, repeats the above 6 options)

End of setup menu.

* Appears only if Impulse ranging set to MANUAL in the Key Operator Menu

REPORT MENU

Summary Reports: Print
Clear

Threshold report: On
Off

Initial Waves: On
Off

Strip charts: 24Hr
12Hr
6Hr
3Hr
1Hr
Off

CH 1 AMPS Rms: Both
Strip chart interval*
Graph
Off

CH 1 AMPS Imp: Both
Strip chart interval*
Graph
Off

CH 1 AMPS Wave: On
Off

NEUT-GND Rms: Both
Strip chart interval*
Graph
Off

NEUT-GND Imp: Both
Strip chart interval*
Graph
Off

NEUT-GND HFN: Both
Strip chart interval*
Graph
Off

(Sensor B with A-111 AC/DC/Impusle Probe - used for AC)

LINE NEUT Rms: Both
Strip chart interval*
Graph
Off

LINE NEUT Imp.: Both
Strip chart interval*
Graph
Off

(Sensor C with A-111 AC/DC/Impusle Probe - used for DC)

LINE NEUT Rms: Both
Strip chart interval*
Graph
Off

LINE NEUT Imp.: Both
Strip chart interval*
Graph
Off

End of report menu.

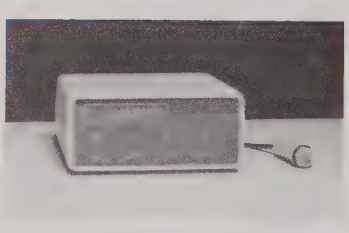
* Strip chart intervals may be selected at 1, 3, 6, 12 or 24 hours.

Chapter 6

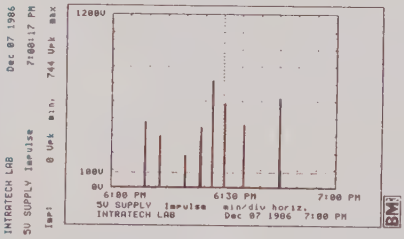
Probes and Accessories

AC/DC/ Impulse Probe

You can use two AC/DC/Impulse probes with the 2400 or 2460 PowerScopes to monitor dual and three-phase power. The A-111 AC/DC/Impulse Probe plugs into a probe channel to add additional voltage monitoring capability. Each A-111 monitors sags, surges, and impulses, and supplies summary strip charts and text disturbance messages.



A-111 AC/DC/Impulse Probe



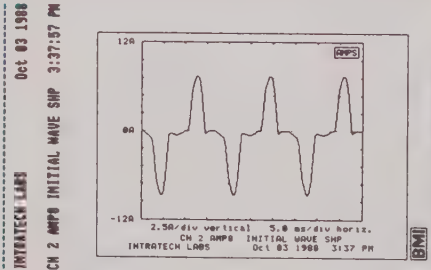
Vdc strip chart from the A-111 AC/DC/ Impulse Probe

Vdc text report from the A-111

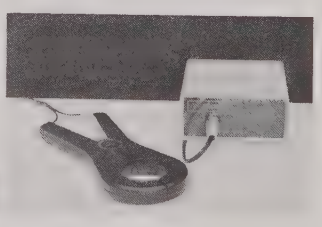
Current Probe

The A-112 Current probe graphs true RMS current. When you plug it into just an environmental sensor channel, it supplies summary strip charts and text disturbance reports. When you plug it into both an environmental sensor channel and a power monitoring channel, it also supplies disturbance graphs.

The probe measures currents with a special wide-band clamp-on probe. The standard clamp measures up to 750 amps, but you can extend its range to several thousand amps by using it on the 5-10 amp secondary of a current transformer.



Current graph



Current Probe

Total Harmonic Distortion

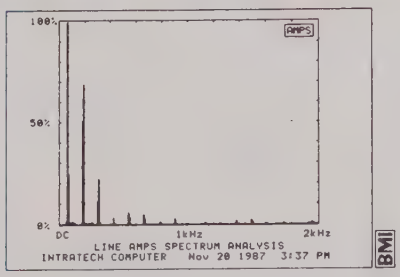
Frequency Spectrum

Disk storage

The A-600 Parallel Processor performs three functions. It stores graphs on 3 1/2 inch IBM-compatible disks, and it performs total harmonic distortion and frequency spectrum analysis for voltage and current. The Parallel Processor plugs into the expansion port on the back of your 2400 PowerScope (the Parallel Processor is built into the 2460), and it comes with PowerTalk Software (see Communications Menu, page 9-2) for transmitting data via telephone line.

Parallel Processor

PowerTalk software



Spectral analysis

HARM	PCT	PHASE	HARM	PCT	PHASE
FUND	100.0%	0°	2nd	0.8%	88°
3rd	68.8%	217°	4th	1.4%	306°
5th	21.4%	76°	6th	0.4%	79°
7th	0.2%	113°	8th	0.2%	119°
9th	0.3%	285°	10th	0.1%	30°
11th	0.1%	228°	12th	0.2%	322°
13th	0.2%	24°	14th	2.0%	211°
15th	0.2%	57°	16th	0.2%	98°
17th	0.2%	24°	18th	0.9%	42°
19th	0.2%	328°	20th	1.0%	76°
21st	0.1%	63°	22nd	1.9%	275°
23rd	0.4%	65°	24th	2.5%	327°
25th	0.4%	178°	26th	0.2%	48°
27th	0.3%	155°	28th	0.3%	184°
29th	0.5%	183°	30th	0.3%	303°
31st	1.3%	69°			
ODD	72.1%		EVEN	4.4%	
THD:	72.2%				

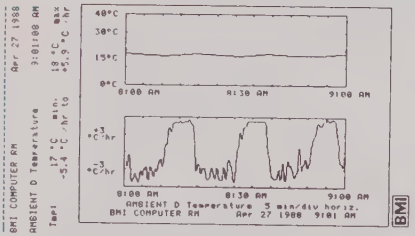
Harmonic distortion

Temperature Probe

These additional PowerScope probes each plug into one probe channel. All, except the Contact Closure probe, supply summary strip charts and text disturbance messages. They include:

The A-002 Temperature Probe graphs temperature and temperature rate-of-change.

Temperature Probe



Temperature strip chart

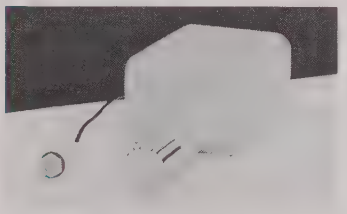
```
INTRATECH                          Apr 23 1988

AIR DUCT  HIGH TEMPERATURE 11:36:25 AM
(Sensor A)

 Temperature above          86 °F
```

```
INTRATECH                          Apr 23 1988

AIR DUCT  HIGH TEMP END    11:40:48 AM
(Sensor A)

 Maximum temperature:       99 °F
```

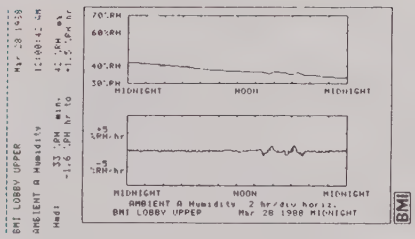
Temperature text report

Temperature/ Humidity Probe

The A-003 Temperature/Humidity probe graphs temperature, temperature rate-of-change, humidity, and humidity rate-of-change.



Temperature/Humidity Probe



Humidity strip chart

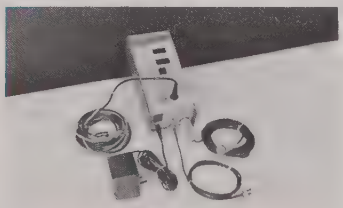
```
INTRATECH                          Apr 23 1988

AIR DUCT  HIGH HUMIDITY            12:19:22 PM
(Sensor A)

 Humidity above                    70 %RH
```

```
INTRATECH                          Apr 23 1988

AIR DUCT  HIGH HMD END             12:21:14 PM
(Sensor A)

 Maximum humidity                  94 %RH
```

Humidity text report

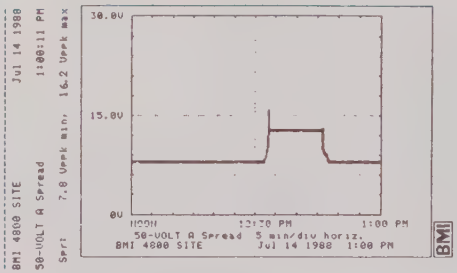
Proportional Supply Probe

The A-005 Proportional Supply probe monitors the 50 V reference supply in 415 Hz computers. It can be used as a stand alone, or plugged into a PowerScope environmental sensor channel to provide strip charts and text reports. It supplies average voltage and superimposed ripple voltage.



Proportional Supply Probe

Proportional Supply Probe, cont'd


BMI 4800 SITE Jul 14 1988 1:00:11 PM
50-VOLT A Spread 7.0 Vpk min, 16.2 Vpk max
Spr:
30.0V
15.0V
0V
NOON 12:30 PM 1:00 PM
50-VOLT A Spread 5 min/div horiz.
BMI 4800 SITE Jul 14 1988 1:00 PM
BMI

Strip chart of DC voltage spread

```
INTRATECH, ROOM 33                Apr 23 1988

STRIP CHART REPORT                      6:00 PM
 From  3:00 PM  To  6:00 PM

PH A-NEUT  (Channel 1)
 Rms:    91.2 Vrms min, 115.4 Vrms max
 Noise:   0.2 Vpk  min,   1.1 Vpk  max
 Freq:   60.0 Hz   min,  60.0 Hz   max
 Imp:       1 counted,   222  Vpk  max

NEUT-GND   (Channel 2)
 Rms:    1.4 Vrms min,> 10.0 Vrms max
 Noise:  0.0 Vpk  min,   0.5 Vpk  max
 Imp:      6 counted, > 200  Vpk  max


50V SUPPLY(Sensor A)
 Avg:    41.0 Vdc  min,  50.5 Vdc  max
 Spr:     0.0 Vppk min,  13.8 Vppk max
```

Text disturbance message.

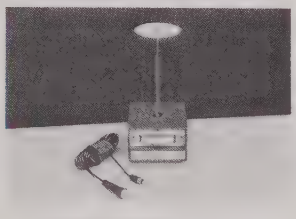
Contact Closure Probe

The A-009 Contact Closure probe connects to alarm systems, attention lights, or other warning systems and provides a 2 second normally open/normally closed contact closure whenever the PowerScope detects an out-of-tolerance condition.

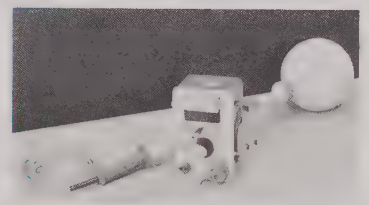
Contact Closure Probe

Contact Closure Probe

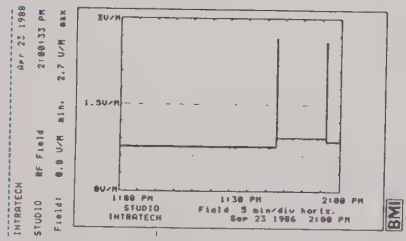
The A-012 and A-014 Radio Frequency Interference Probe Interfaces include a cable and software for Instruments for Industry's EFS-3 and Holaday Industries' HI-3004 radio frequency interference probes.



A-012 RFI Probe Interface



A-014 RFI Probe Interface



Radio frequency interference strip chart

Accessories

A-201 Rack Mount
For a permanent installation of the 2400 or 2460, choose the A-201 rack mount. It fits in a standard 19" rack, and occupies 8 5/8 vertical inches of rack space.

A-013 Accessory rack mount
The Accessory rack mount holds the A-600 Parallel Processor.

A-018 Dual Probe rack mount
Holds one or two probes in place: A-111 AC/DC/Impulse Probe, A-112 Contact Closure Probe, or A-016 Precision Calibrator.

G-206 Internal modem
When you want to set up a PowerScope network, you can chose the G-206 internal modem. PowerScopes with modems can communicate either with other PowerScopes or with IBM PC's running PowerTalk software.

G-010 PowerTalk Software
PowerTalk software lets you use your IBM PC or compatible to control a network of PowerScopes via modem or RS-232 port (see Communications chapter, 9-2). PowerTalk is packaged with the A-600 Parallel Processor and with the 2460 PowerScope (see Chapter 7-2).

Handbook of Power Signatures

The *Handbook of Power Signatures* is a reference book on power and environmental disturbances. Over 100 disturbances contributed by leading power experts are included along with a step-by-step power survey, high- and low-frequency models of power lines, grounding information, and safety suggestions.

Waveshape fault - loose wiring

Identifying features

The waveshape fault exhibits repeated local power failure (page 76) and local power re-applied (page 80) symptoms, especially during intervals when the wiring system is physically jostled by earthquakes, passing trucks, thunder, elevator operation, or construction work, or during rapid increases in load. Impulses will frequently be observed if the impulse threshold is low enough.

This type of waveshape fault can be difficult to distinguish from gas discharge suppression waveshapes (page 88); the key difference is that with gas discharge suppressors the sine wave is always restored at a zero-crossing after less than one-half cycle, but with loose wiring or connectors, the sine wave will sometimes be restored at a non-zero-crossing point (as in the example at right).

Cause

Loose wiring or connections in the building or local distribution system are disrupting the power. The disruption can be triggered mechanically or electrically due to expanding gasses during arcing forcing the conductors apart (due to high humidity, abrupt increase in load, etc.).

Symptoms

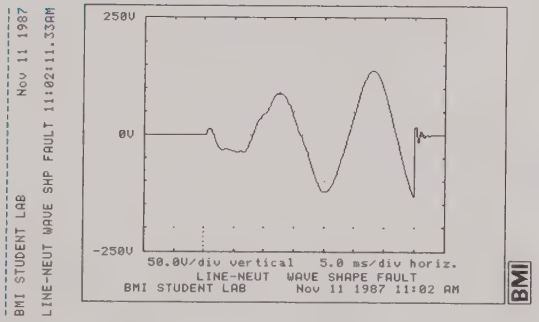
Equipment will typically respond as though a brief voltage sag has occurred. Data disruption may occur. Power-on reset circuits may be triggered unexpectedly. Overheating and fire may occur at the point of the loose connection.

Solutions

Locate and repair the connection. The higher the frequencies observed in the graph, the closer the loose connection is to the monitoring point (see the high frequency model of power lines on page 26).

Although mitigating devices with energy storage can eliminate the effects of this disturbance, it can be dangerous to leave the cause in place, so they are not recommended.

Waveshape fault - loose wiring



Related to

Impulse - loose wiring, page 106
High frequency model of power lines, page 26

Contrast with

Waveshape fault - gas discharge surge arrestor, page 88
Waveshape fault - switching between two power sources, page 86
Waveshape fault - out-of-phase source, page 68

Chapter 7

If you have a 2460

Description

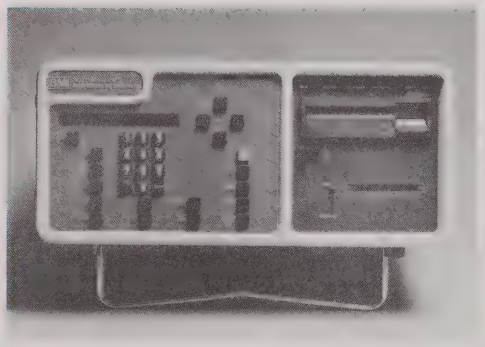
NOTE: This chapter describes how to operate the BMI 2460 PowerScope. The 2460 PowerScope includes a Parallel Processor, for harmonic and spectrum analysis and for storing information on a standard 3.5 inch floppy disk. There is no paper take-up for the printer.

Quick Guide

1. Storage and printing of graphs and reports is accomplished through the STORAGE menu. Press the SETUP key, quickly followed by the Up arrow to access the STORAGE menu.

2. Harmonic analysis and Total Harmonic Distortion reports are obtained by pressing the STATUS key, quickly followed by the Up arrow. The SETUP and connections must be completed first.

3. Report writing and manipulation of graphs and text reports is accomplished through PowerTalk Software. This is described in a separate brochure entitled "G-010 PowerTalk Users Guide."



Front view of the 2460 PowerScope.

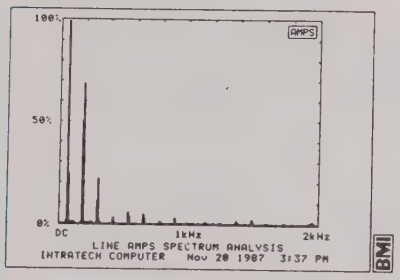
Setup and Report Menus

The Setup and Report menus for the 2460 are the same as the 2400. See the appropriate chapter (Single-phase, Dual One-phase, etc.).

Harmonic Analysis & THD

To obtain a harmonic analysis and frequency spectrum report, press the STATUS key quickly followed by the Up arrow. The following type of report will be produced.

You may also select harmonic analysis at regular intervals using PowerTalk Software. This is described more fully in the PowerTalk Users Guide.



Harmonic analysis report.

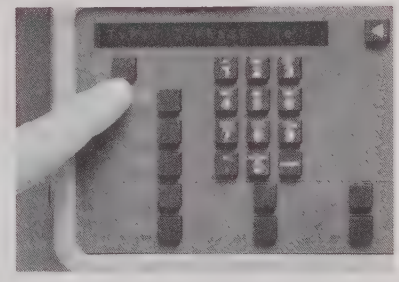
HARM	PCT	PHASE	HARM	PCT	PHASE
FUND	100.0%	0°	2nd	0.8%	88°
3rd	68.8%	217°	4th	1.4%	306°
5th	21.4%	76°	6th	0.4%	79°
7th	0.2%	113°	8th	0.2%	119°
9th	0.3%	285°	10th	0.1%	30°
11th	0.1%	228°	12th	0.2%	322°
13th	0.2%	24°	14th	2.0%	211°
15th	0.2%	57°	16th	0.2%	98°
17th	0.2%	24°	18th	0.3%	42°
19th	0.2%	328°	20th	1.0%	76°
21st	0.1%	63°	22nd	1.9%	275°
23rd	0.4%	65°	24th	2.3%	327°
25th	0.4%	178°	26th	0.2%	48°
27th	0.3%	155°	28th	0.8%	184°
29th	0.5%	183°	30th	0.3%	303°
31st	1.3%	69°			
ODD	72.1%		EVEN	4.4%	
THD:	72.2%				

Total Harmonic Distortion report.

Storage Menu

Use the STORAGE menu to select options for the disk drive that is built into the 2460 PowerScope.

To begin, press the Setup Key, quickly followed by the Up arrow. The Key Operator menu will appear.



To reach the Storage menu, press the SETUP key, quickly followed by the Up arrow. Then, press the Value Down key twice to display the Storage menu.

Menu: Key Operator

Selections: Key Operator
Communication
Storage

Press the VALUE DOWN key twice. With the first press, the Communication menu will appear, and with the second the Storage menu will appear. Now, press the Down Arrow.

Mode: Idle

Selections: Idle
Record
Playback
Initialize

Use the VALUE UP/VALUE DOWN keys to select mode idle to turn off the 2460's disk drive. The printer will still operate.

Use the Value Up/Value Down keys to select which mode you want. There are four selections:

Idle - turns the disk drive off. The 2460 can still monitor, however there will be no storage to the disk drive.

Record - saves disturbance graphs and text reports to disk. Whenever there is a disturbance or strip chart, the information will be stored on disk. The disk holds 720k of memory, approximately 700 graphs. The printer may be on or off at the same time.

Playback- retrieves graphs and text reports from the disk and prints them. You may print a list of the files on the disk, print all files, or selected files.

Initialize - prepares a new disk to store data. Insert a blank disk in the disk drive before you choose this option.

Next, press the Down Arrow. The next questions to appear will depend on which selection you make here.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select a menu.

     You have three choices:

Key Operator -
     Lets you control the administra-
     tive detail of your PowerScope,
     including the clock and the
     calendar.

Communication -
     Lets you control the PowerScope
     modem and RS-232 port.

Storage -
     Lets you control the optional
     A-600 Parallel Processor.

(There is no more HELP!)

=====================================
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the operating mode for the
Parallel Processor.

     You have four choices:

IDLE -
     The Parallel Processor will
     indicate it is connected to the
     PowerScope, but it is not setup
     to record or playback files.
     However, it will still perform
     harmonic content and spectral
     analysis when you press STATUS
     then up arrow on the PowerScope's
     keyboard.

RECORD -
     The Parallel Processor will
     record graphs and reports on
     disk.

PLAYBACK -
     The Parallel Processor will send
     (1) all files, (2) one selected
     file, or (3) the file list to the
     PowerScope for printing.

INITIALIZE -
     The Parallel Processor will erase
     and then initialize a disk.

(There is no more HELP!)

=====================================
```

Mode: Record

Mode: Record

Use the VALUE UP/VALUE DOWN keys to select mode: record to automatically store graphs and reports to disk.

The 2460 PowerScope automatically names the data file using the Day-Month-Year format, such as 25JAN89. If you stop and restart recording on the same day, the file will be appended. Restarting will not erase data from previous sessions.

Press the down arrow.

Printer: On

Selections: On
Off

Use the VALUE UP/VALUE DOWN keys to turn the printer on or off.

If you plan to analyze disturbances in the field, you may want to leave the printer on. If you plan to retrieve the disk and play back disturbances on a computer at a later time, you may want to shut the printer off. This will also save you paper.

Press the Down Arrow.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the operating mode for the
Parallel Processor.

     You have four choices:

IDLE -
     The Parallel Processor will
     indicate it is connected to the
     PowerScope, but it is not setup
     to record or playback files.
     However, it will still perform
     harmonic content and spectral
     analysis when you press STATUS
     then up arrow on the PowerScope's
     keyboard.

RECORD -
     The Parallel Processor will
     record graphs and reports on
     disk.

PLAYBACK -
     The Parallel Processor will send
     (1) all files, (2) one selected
     file, or (3) the file list to the
     PowerScope for printing.

INITIALIZE -
     The Parallel Processor will erase
     and then initialize a disk.

(There is no more HELP!)

=====================================
```


If you have a 2460

Storage Menu, Continued

Mode: Record

Mode: Playback

Use the VALUE UP/VALUE DOWN keys to select mode: playback to retrieve all or selected files from the disk and have them printed.

Press the down arrow.

Playback: File list

Selections: Quit
File list
All files
25JAN89
(Individual files by name)

Use the VALUE UP/VALUE DOWN keys to choose what you want to do next. Your choices are:

Playback: Quit - exits from the Playback mode.

Playback: File list - prints a list of the file names on the disk.

Playback: All files - prints all files on the disk. If you select this by accident, and want to cancel the printing, press the CANCEL PRINT key, quickly followed by the Up Arrow.

Playback: (Individual file name) - plays back the named file.

Press the down arrow after you've made your selection.

Mode: Initialize

Use the VALUE UP/VALUE DOWN keys to select mode: initialize to initialize a disk. Then press the down arrow.

Initialize: Drive A

Selections: Quit
Drive A

Use the VALUE UP/VALUE DOWN keys to choose what you want to do next. Your choices are:

Mode: Initialize - prepares a disk to record data. If the disk is already formatted, then initializing will erase all files on that disk.

Initialize: Quit - exits from this option.

Press the down arrow.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the operating mode for the
Parallel Processor.

     You have four choices:

IDLE -
     The Parallel Processor will
     indicate it is connected to the
     PowerScope, but it is not setup
     to record or playback files.
     However, it will still perform
     harmonic content and spectral
     analysis when you press STATUS
     then up arrow on the PowerScope's
     keyboard.

RECORD -
     The Parallel Processor will
     record graphs and reports on
     disk.

PLAYBACK -
     The Parallel Processor will send
     (1) all files, (2) one selected
     file, or (3) the file list to the
     PowerScope for printing.

INITIALIZE -
     The Parallel Processor will erase
     and then initialize a disk.

(There is no more HELP!)

=====================================
```


If you have a 2460

Chapter 8

Key Operator Menu

8. Key Operator Menu

The Key Operator menu lets you control administrative detail, such as the calendar and clock, Centigrade or Fahrenheit temperature scale, etc.

Quick Guide to the Key Operator Menu

1. Press the SETUP MENU key, then quickly press the up arrow.

2. Use the VALUE UP/VALUE DOWN keys or the number letter keypad to answer the questions in the menu.

3. Press the down arrow to go to the next question.

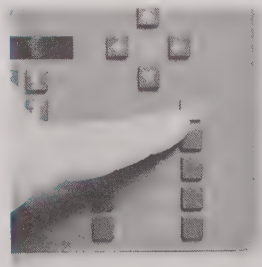
4. Press the HELP! key if you want further explanation about the questions.

Help: English

Selections: English
French

Use the VALUE UP/ VALUE DOWN keys to select the language you prefer for the HELP messages.

(The menus and reports are always printed in English.)



Help messages may be in English or French.

```
====================================

Sélectionnez '3-phase Y' pour
surveiller un système triphasé
étoile à 5 fils avec des conducteurs
de neutre et de terre séparés.

Vous avez besoin de deux 'A-111
AC/DC/Impulse Probes', enfiché dans
les 'Environmental Sensor' prises
'A' et 'B'.

Pour installer le PowerScope sur un
secteur triphasé étoile, faire les
connexions suivantes :

Canal 1 - Borne VERTE : TERRE DE
                        PROTECTION

Canal 1 - Borne ROUGE : Phase A
Canal 1 - Borne NOIRE : Neutre

Canal 2 - Borne ROUGE : Neutre
Canal 2 - Borne NOIRE : Terre

Environmental Sensor A:
A-111 - Borne ROUGE :   Phase B
A-111 - Borne NOIRE :   Neutre

Environmental Sensor B:
A-111 - Borne ROUGE :   Phase C
A-111 - Borne NOIRE :   Neutre

(Pressez la touche 'HELP!' de
nouveau pour des renseignements
généraux sur le 'Setup Menu'
(Menu des définitions).)

====================================
```

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to select the language of your choice for help messages, English or French.

(Press HELP! again for general information on the Key Operator Menu).

==========

The Key Operator Menu contains questions that define some of the detailed operation of your PowerScope.

These questions request information on language, clock, internal ups, temperature, impedence, frequency, waveshape, hysteresis, and impulse ranging.

(Press HELP! again for general information on the operating sequence.)

==========

The usual sequence for operating the PowerScope monitor is:

1) Press the SETUP MENU key and answer the questions. To go on to the next question, press the Down Arrow.

2) Connect the monitor to the power line. (See the HELP! message in the Setup Menu for the 'TYPE:' question.)

3) Press the MONITOR key to monitor the power line. Your reports will be printed automatically.

(Press HELP! again for general information on the six modes of operation.)

==========

==========

The PowerScope monitor can be in one of six modes:

1) Press the SETUP MENU key to program the Setup Menu. Use the up arrow and the down arrow key to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu. (You may want to press 'HELP!' when you have selected the type of power line you are going to monitor. This will give you installation instructions.) By pressing the SETUP MENU key, then immediately pressing the UP ARROW key, you will enter the Key Operator Menu. This menu will give you control of the detailed operation of the PowerScope.

2) Press the STATUS key to print the Status Report. This report tells you the present voltage, frequency, and noise on each of the channels. This report can be especially useful when you're trying to set the thresholds correctly. It's also useful for checking to see if you've installed the monitor correctly.

3) Press the REPORT MENU key to enter the Report menu. Use the up arrow and the down arrow to work your way through the questions on the menu. The 'HELP!' key will always give you information on a question on the menu.

(Continued on page 5)

Selection: Standard
W.G.P.Q.

Use the VALUE UP/VALUE DOWN keys to select standard terminology or the Working Group on Power Quality (W.G.P.Q.) terminology.

Equivalent words:

Standard	W.G.P.Q.
IMPULSE	SURGE
SURGE	SWELL
SAG	SAG

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to select standard terminology or Working Group on Power Quality terminology.

Equivalent words:

Standard	W.G.P.Q.
IMPULSE	SURGE
SURGE	SWELL
SAG	SAG

(There is no more HELP!)

==========

(Continued from page 3)

4) Press the MONITOR key to start monitoring the power line. The PowerScope will print a complete copy of your setup, and show you the initial waveshapes on each channel (if you have requested them in the Report Menu). Then it will print a disturbance report every time a power disturbance occurs.

5) Press the CALIBRATION key to calibrate your PowerScope. To calibrate your PowerScope, you must connect an external A-016 Precision Calibrator to the PowerScope; If you haven't connected one, the PowerScope will print its most recent calibration data.

6) Press the SELF TEST key to test the PowerScope.

(There is no more HELP!)

==========

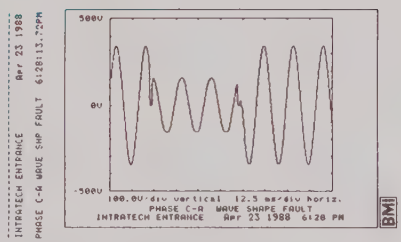
8. Key Operator Menu

Wave Shp: 0.1 cycles

Range: 0.1cycles to 9.9 cycles

Use the number keys to enter the minimum duration for waveshape faults.

A typical value is 0.2 cycles. The acceptable range is 0.1 cycles to 9.9 cycles.



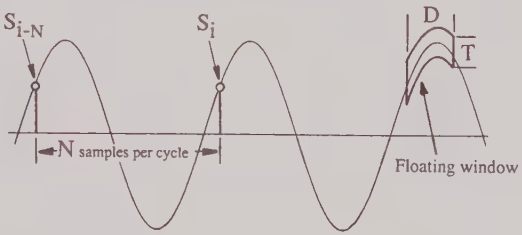
Waveshape disturbance graph.

A waveshape fault that is shorter than the minimum duration that you enter here will not trigger a waveshape fault graph; a waveshape fault that is longer than the minimum duration will trigger a waveshape fault graph.

Wave tolerance: 2%

Range: 2% to 99%

Use the number keys to enter the minimum amplitude of waveshape faults as a percentage of full scale.



The range is 2% to 99%.
A typical value is 20%.
Waveshape faults are detected by comparing each sine wave to the previous one.

HELP!

```
=====================================

Use the number keys to enter the
minimum waveshape fault duration.

The PowerScope will measure the
instantaneous voltage of a fraction of
an ac cycle and compare it to the same
part of the previous cycle.  This step
of the Setup procedure asks you to
select the minimum duration of
waveshape faults to the nearest 0.1
cycle.  You may select any duration
from 0.1 cycle to 9.9 cycles.  A
reasonable value is 0.2 cycles.

(Press HELP! again for general infor-
mation on the Key Operator menu.)

=====================================
```

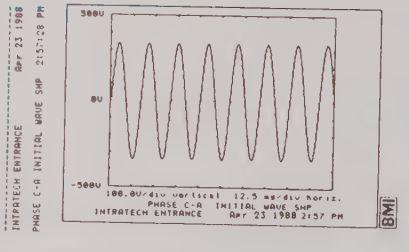
```
=====================================

Use the number keys to enter the
waveshape fault tolerance.

The PowerScope will measure the
instantaneous voltage of a fraction
of an ac cycle and compare it to the
same part of the previous cycle.  This
question asks you to decide how much,
as a percentage of full scale, the
measurement has to change to produce
a Wave Shape Disturbance Report.  You
may select any percentage from 2% to
99%.  A reasonable value is 10%.

(Press HELP! again for general infor-
mation on the Key Operator Menu.)

=====================================
```

Wave Res: 5.0 msec

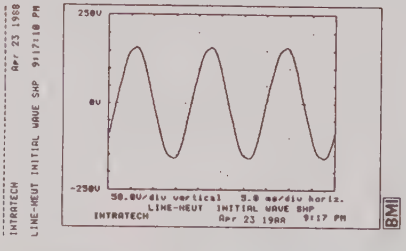
Selections: 5.0 msec
12.5 msec

Use the VALUE UP/ VALUE DOWN keys to select either high or normal resolution for waveshape fault graphs and initial waveshape graphs.

High resolution prints 5.0 ms/division and normal resolution prints 12.5 ms/division. The difference between the two are shown here.



12.5 ms/division resolution.



5.0 ms/division resolution.

HELP!

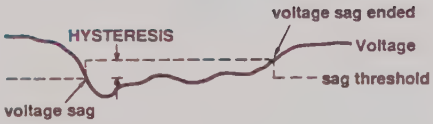
```
====================================

Use the VALUE UP/VALUE DOWN keys to
select either high or normal
resolution for waveshape fault and
initial waveshape graphs.

High resolution prints 5.0 ms/division
and normal resolution prints 12.5
ms/division.

(There is no more HELP!)

====================================
```

8. Key Operator Menu

Hysteresis 1.0%

Range: 0.0% to 5.0%

Use the number keys to enter the hysteresis as a percentage of full scale.



The acceptable range is 0.0% to 5.0%. A typical value is 1.0%.

Hysteresis is an amount by which a threshold is altered in order to suppress disturbance graphs that would otherwise be triggered by small fluctuations in the measured signal.

If hysteresis is used, the threshold is altered by the specified percentage after an initial disturbance is triggered until the signal crosses the altered threshold. At this time, the threshold is restored to its original level. If you don't want hysteresis, enter 0.0% for the threshold.

Hysteresis is applied to thresholds set for probes, voltage, and high-frequency noise.

HELP!

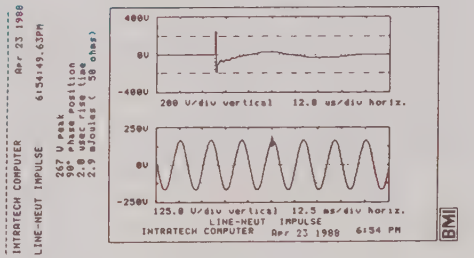
```
====================================

Use the number keys to enter the
hysteresis as a percentage of full
scale The acceptable range is 0.0% to
5.0%. A typical value is 1.0%.

(Press HELP! again for more infor-
mation on hysteresis).

====================================
```

```
====================================

Hysteresis is an amount by which a
threshold is changed in order to
suppress disturbance reports that
would normally be triggered by small
fluctuations in the measured signal.

If hysteresis is used, the threshold
will be changed by the specified
percentage when an initial
disturbance is triggered.  Another
disturbance will be triggered when
the signal crosses the new threshold.
At this time, the threshold is
restored to its original level.

If you don't want hysteresis, enter
0.0 % for the threshold.

(Press HELP! again for general infor-
mation on the Setup Menu).

====================================
```

Impulse range: Auto

Selections: Auto
Manual

Use the VALUE UP/ VALUE DOWN keys to choose automatic or manual impulse ranging.



If you choose automatic impulse ranging, your PowerScope automatically uses your impulse threshold to choose a full-scale range.

Manual Impulse Ranging Table

Impulse Threshold	Available Full-Scale Ranges
20-24 Vpk	+/-100 or 200 volts full-scale
24-49 Vpk	+/-100, 200 or 400 volts full-scale
50 Vpk	+/-100, 200, 400 or 800 volts full-scale
51-99 Vpk	+/-200, 400 or 800 volts full-scale
100 Vpk	+/-200, 400, 800 or 1600 volts full-scale
101-199 Vpk	+/-400, 800 or 1600 volts full-scale
200 Vpk	+/-400, 800, 1600 or 3200 volts full-scale
201-399 Vpk	+/-800, 1600 or 3200 volts full-scale
400 Vpk	+/-800, 1600, 3200 or 6400 volts full-scale
401-800 Vpk	+/-1600, 3200 or 6400 volts full-scale

However, if you choose manual impulse ranging, your PowerScope will ask you to choose a full-scale range. The choices offered you depend on the selected impulse threshold as follows:

Automatic Impulse Ranging Table

If Impulse Threshold selected in previous question is between...	The Impulse Range will set automatically to...
20 - 50 volts	+/- 100 volts
51 - 100 volts	+/- 200 volts
101 - 200 volts	+/- 400 volts
201 - 400 volts	+/- 800 volts
401 - 800 volts	+/- 1600 volts
801 - 1600 volts	+/- 3200 volts
1601- 6000 volts	+/- 6400 volts

In applications where you know the size of impulses that disrupt equipment, it makes sense to choose automatic impulse ranging. In applications where you're trying to characterize a power line, it may make more sense to choose manual impulse ranging, then select the largest full-scale range available.

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to choose either AUTOMATIC or MANUAL selection of full scale impulse ranges.

(Press HELP! again for more information on answering this question).

==========

==========

If you choose MANUAL selection of full scale impulse ranges, you will be asked to choose a full scale range every time you enter an impulse threshold.

If you choose AUTOMATIC selection, the ranges will be selected for you.

(Press HELP! again for a chart showing the relationship of impulse thresholds to full scale range when AUTOMATIC is selected.)

==========

==========

Impulse threshold	Full Scale Range
20 - 50 Vpk	100 Vpk
51 - 100 Vpk	200 Vpk
101 - 200 Vpk	400 Vpk
201 - 400 Vpk	800 Vpk
401 - 800 Vpk	1600 Vpk
801 - 1600 Vpk	3200 Vpk
1601 - 6000 Vpk	6400 Vpk

(Press HELP! again for general information on the Key Operator Menu.)

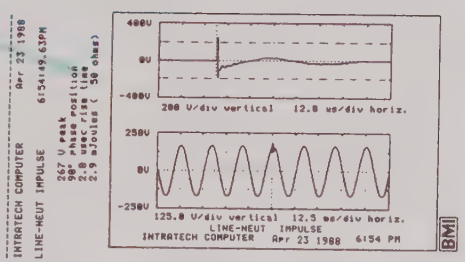
==========

8. Key Operator Menu

Line imp: 50 ohms

Range: 1 ohm to 9,999 ohms

Use the number keys to enter the estimated impedance of the power line at impulse frequencies.



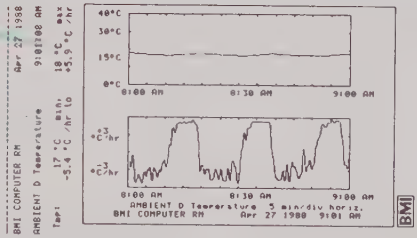
The acceptable range is 1 ohm to 9,999 ohms. Fifty ohms is a reasonable value, unless you are measuring downstream from a power conditioner, where a value of a few hundred ohms is more typical.

The impedance is used in the calculatuion of approximate impulse energy. It has a second-order effect (the calculation is dominated by the integral of the voltage, which is squared). For a discussion of typical values, see J.H. Bull, "Impedance of the Mains Supply at Radio Frequencies," Proceedings of the 1st Symposium on EMC, MONTREUX, 75CH1012-4, pp. 357-362, May 1975.

Temp. units: C

Selections: C
F

Use the VALUE UP/ VALUE DOWN keys to select temperature readings in Centigrade or Fahrenheit.



This controls both Temperature probes and Temperature/humidity probes.

HELP!

==========

Use the number keys to enter the value of your line impedance at impulse frequencies (e.g. 100 KHz). This entry is used in calculating the energy of an impulse. If you cannot determine the impedance of the line being monitored, a typical value is 50 ohms. The acceptable range is 10 ohms to 9,999 ohms.

(There is no more HELP!)

==========

==========

Use the VALUE UP/VALUE DOWN keys to enter the temperature units you prefer, Celcius or Fahrenheit. All temperature and rate-of-temperature change thresholds and readings will be adjusted automatically.

(Press HELP! again for general information on the Key Operator Menu.)

==========

Internal UPS: 5 min

Range: 0 min to 15 min

Use the number keys to enter the length of time the internal batteries should support the PowerScope if power fails.

The range is 0 to 15 minutes with fully charged batteries. A typical value is 5 minutes (to capture most disturbances associated with a power failure, yet not consume all battery power during the first power failure that occurs).

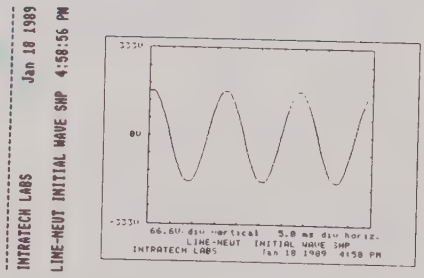
The PowerScope uses its batteries only while it's monitoring; a power failure while you're setting up your PowerScope will cause a simple power-down procedure.

```
=====================================

BMI 2400 SITE                Jan 01 1988

THRESHOLD REPORT               12:37 AM

Type:      3-phase wye

PH A-NEUT THRESHOLDS (Channel 1)
      Surge voltage:  125.0 Vrms
      Sag voltage:    105.0 Vrms
      Impulse:          200 Vpk
      High freq noise: 10.0 Vpk
      High frequency:  61.2 Hz
      Low  frequency:  58.8 Hz
      Wave shape:       20% variation
      Minimum duration: 0.1 cycles
      Line impedance:    50 ohms
      Hysteresis:      1.0%

NEUT-GND THRESHOLDS (Channel 2)
      Surge voltage:    5.0 Vrms
      Impulse:          100 Vpk
      High freq noise: 10.0 Vpk
      Line impedance:    50 ohms
      Hysteresis:      1.0%

PH B-NEUT THRESHOLDS (Sensor A)
      Surge voltage:  125.0 Vrms
      Sag voltage:    105.0 Vrms
      Impulse:          100 Vpk

PH C-NEUT THRESHOLDS (Sensor B)
      Surge voltage:  125.0 Vrms
      Sag voltage:    105.0 Vrms
      Impulse:          100 Vpk

SUMMARY REPORT INTERVAL:  Off

Internal UPS time:  5 minutes.
```

Current month: Jan

Range: Jan to Dec

Use the VALUE UP/ VALUE DOWN keys to select the current month.



HELP!

```
====================================

Use the number keys to enter the
number of minutes the internal
batteries should support the
PowerScope after a power failure.

The PowerScope's internal batteries
will provide full operation for up
to 15 minutes during a power failure,
after which it goes to a standby
condition with the clock and memories
maintained.  If you plan on frequent
power failures, you may wish to enter
a shorter UPS (Uninterruptable Power
Supply) time.

The acceptable range is 0 to 15
minutes. A typical value is 5 minutes.

(The internal batteries only provide
extended support when the instru-
ment is in the Monitor mode.)

(Press HELP! again for general infor-
mation on the operating sequence.)

====================================
```

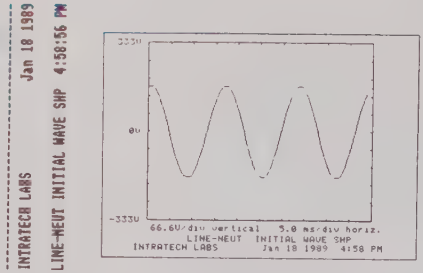
```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the current month.

(Press HELP! again for general
information on the Key Operator
Menu.)

====================================
```

8. Key Operator Menu

Day of Month: 18

Range: 1 to 31

Use the number keys to enter the current date.

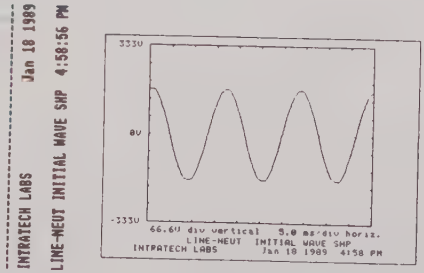


Current Year: 1989

Range: 1986 to 2099

Use the number keys to enter the current year.

Acceptable values are 1986 to 2099.



HELP!

```
=====================================

Use the number keys to enter the
current date. The acceptable range
is from 1 to 31.

=====================================
```

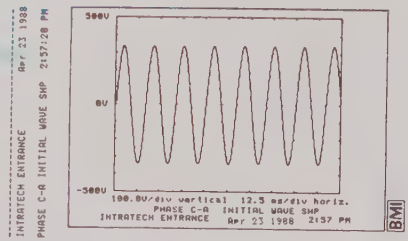
```
=====================================

Use the number keys to enter the
current year.  Use four digits
(e.g. 1988).  The acceptable range is
1988 - 2099.

(Press HELP! again for general infor-
mation on the operating sequence.)

=====================================
```

Date: U.S. standard

Selections: U.S. standard
Eur. standard

Use the VALUE UP/ VALUE DOWN keys to select the date format you prefer.

The U.S. standard form is April 23, 1988: the European standard for the same date is 23 April, 1988.

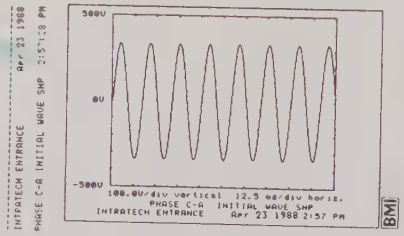


Current hour: 2

Range: 0 to 23

Use the number keys to enter the current hour on a 24-hour clock.

For example, if it is 6:00 in the evening, you must enter 18 here. The acceptable range is 0 to 23.



HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select either European format:

              DD/MM/YY

or American format:

              MM/DD/YY

(There is no more HELP!)

=====================================
```

```
=====================================

Use the numbers keys to enter the
current hour. When setting time of
day, ALWAYS enter the hours using
24-hour military-style time. For
example, to enter 1:00 PM, enter
13. Later in this menu you have an
opportunity to select either AM/PM
or 24 HOUR time. The conversions will
be made automatically and appear on
the printouts that way.

(Press HELP! again for general infor-
mation on the operating sequence.)

=====================================
```


8. Key Operator Menu
12. Troubleshooting
13. Specifications

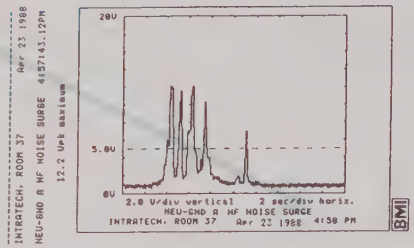
Current Minute: 58

Range: 1 to 59

Use the number keys to enter the current minute.

The clock will be set when you step off this question, with the seconds set to zero.

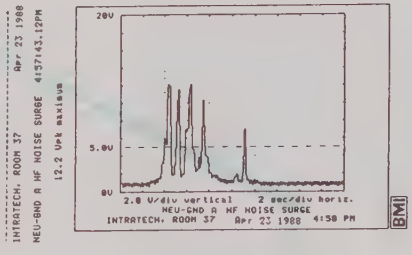
(If you haven't changed the clock, the seconds won't be disturbed.)



Time: A.M./P.M.

Selections: 24 hour

Use the VALUE UP/ VALUE DOWN keys to select A.M./P.M. or military time display.



A.M./P.M. time display would read 4:58 PM. Military time display would read 16:58.

HELP!

```
====================================

Use the number keys to enter the
time to the nearest minute, 0 to 59.

(Press HELP! again for general infor-
mation on the operating sequence.)

====================================
```

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select either AM/PM or 24-hour
military-style time reporting.

(There is no more HELP!)

====================================
```

8. Key Operator Menu

MEM#1 Name: MEMORY#1

Use the number/letter keypad to name this memory slot.

Usually, you'll want to name it for the type of equipment the setup is used for, e.g. VAX 11/80.

To enter the letter "M", press the 6MNO key twice. On the first press a 6 will appear, on the second press an M will appear.

Move the flashing cursor to the next position by pressing the right arrow key. Press the CLEAR key to enter a space.

MEMORY#1: Read/Write

Selections: Read/Write
Read Only

Use the VALUE UP/VALUE DOWN keys to control access to this memory slot.

If you want to ensure the contents of this memory will not change, position Read Only in the display. If you want to be free to store other setups in this memory slot, position Read/Write in the display. Press the down arrow to go on to the next question.

NOTE: The questions on this page are repeated for MEMORY #2 and MEMORY #3.

HELP!

```
=====================================

Use the number keys to enter up to 9
characters to name this memory.   It's
best to name the memory either for the
type of equipment being monitored,
for example: VAX11/780.

(Press HELP! for additional informa-
tion on answering this question.)

=====================================

=====================================

Use the left and right arrow keys to
move the flashing cursor.   Use the
number keys to enter both letters and
numbers.  For example, to enter the
letter 'b', push the '2ABC' key three
times.  Then move the flashing cursor
to the next character.

(There is no more HELP!)

=====================================

=====================================

Use the VALUE UP/VALUE DOWN keys to
select whether this memory should be
protected or not.

Your choices are READ/WRITE, meaning
the memory can be accessed and
changed, or READ ONLY, meaning it
can't be changed.

(There is no more HELP!)

=====================================
```


8. Key Operator Menu

Chapter 9

Communication Menu

9. Communications Menu

The Communication menu lets you control the PowerScope modem and RS-232 port .

Quick Guide to Modem and RS-232 Operation

1. Press SETUP MENU, then the up arrow key. Use the VALUE DOWN key to select "Menu: Communication".

2. Use the VALUE UP/VALUE DOWN keys to select "Port: Internal Modem (or External Modem or RS-232)". Press the down arrow.

3. Use the VALUE UP/VALUE DOWN keys to select "Modem: Tel Numbers (modem only)". Enter the names and phone numbers of all the PowerScopes in your network.

4. Decide if this PowerScope is the master PowerScope or one of your slave PowerScopes.

If it's the master PowerScope:

A. Scroll back to "Modem: Tel Numbers (or Port: RS-232)". Use the VALUE DOWN key to select "Type"; then select "Type: Master".

B. Choose a slave PowerScope to connect to. Your master PowerScope will call the selected slave PowerScope, and the master's keyboard, printer, and display will take over the slave's keyboard, printer, and display. (If you choose QUIT instead of a slave PowerScope, your master PowerScope will wait for a slave PowerScope to call.)

If it's one of the slave PowerScopes:

A. Scroll back to "Modem: Tel Numbers (or Port: RS-232)". Use the VALUE DOWN key to select "Type: Slave". Press the down arrow.

B. Choose the name of the Master PowerScope from your telephone directory and enter it in "Master: (for modem only)".

C. Use the next questions to turn the slave printer off, and to hold the line for 2 minutes after transmitting data to the master.

D. You can check your phone or RS-232 connection to the master PowerScope.

E. Press MONITOR, then press LOCK to lock the keyboard. All disturbances will be printed at the master PowerScope.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select a menu.

     You have three choices:

Key Operator -
     Lets you control the administra-
     tive detail of your PowerScope,
     including the clock and the
     calendar.

Communication -
     Lets you control the PowerScope
     modem and RS-232 port.

Storage -
     Lets you control the optional
     A-600 Parallel Processor.

(There is no more HELP!)

====================================
```

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select a data communications option.

     You have four choices:

Off -
     Your PowerScope will not use
     either its RS-232 or modem ports.
     It's important to choose this
     option if you aren't making
     connection to either port.

RS-232 -
     Your PowerScope will send graphs
     and reports via the RS-232 port.

External Modem -
     Your PowerScope will send graphs
     and reports via an external Hayes
     Smartmodem 2400 plugged into the
     RS-232 port.

Internal Modem -
     Your PowerScope will send graphs
     and reports via its internal
     modem.

(There is no more HELP!)

====================================
```

9. Communications Menu

Internal modem

Do you have an internal modem?

Press the CALIBRATION button. You will get a printout of the configuration of your PowerScope. It will tell you if you have a modem.

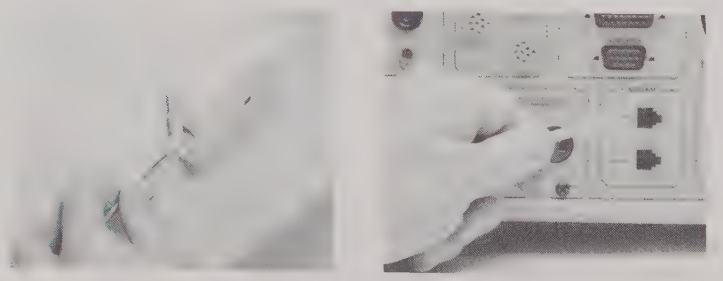
```
BNI 2400 SITE                Oct 13 1988

SELF TEST REPORT                  8:26 AM

    BOARD      HARDWARE    FIRMWARE
    -----      --------    --------
    I/O        Rev. C      E0.3
    Math       Rev. F      E0.3
    Acq 1      Rev. F      E0.1
    Acq 2      Rev. F      E0.1

Envir sensor A: No probe installed
Envir sensor B: No probe installed
Envir sensor C: No probe installed
Envir sensor D: No probe installed

Options supported:
    BNI A002 Temperature Probe
    BNI A003 Temperature/Humidity Probe
    BNI A005 Proportional Supply Probe
    BNI A009 Contact Closure Probe
    BNI A111 AC/DC Voltage/Impulse Probe
    BNI A112 Current Probe
    BNI A500 Parallel Processor
    IFI EFS-3 RF Field Strength Probe

Modem is     installed.

Communication port: Off.
```

Modem is installed.

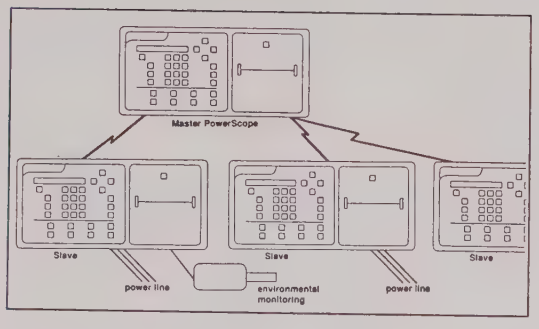
```
SELF TEST PASSED.
```

Connecting the modem

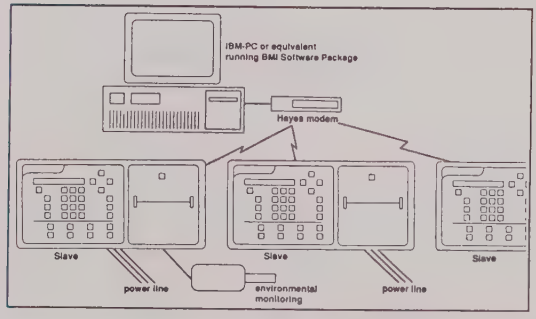
Use the RJ-11 cable supplied with your PowerScope to connect from the "LINE" connector to a standard modular telephone outlet. If you want to use a standard telephone on the same line (when the PowerScope isn't using the line), plug the telephone into the "TEL" connector.



The RJ-11 cable connects the "LINE" connector on the PowerScope to the telephone outlet.



Typical PowerScope network.



Computer-controlled PowerScope network (BMI PowerTalk™ Software, Model G-010).

The modem allows you to form a PowerScope network. Each network has one *master* PowerScope and one or more *slave* PowerScopes. Every PowerScope in the network must have a modem.

The *slave* PowerScopes monitor power and environmental disturbances, and report the disturbances to the master PowerScope.

The *master* PowerScope prints the disturbances, and controls all aspects of the slave PowerScopes, including their Setup and Report Menus.

Typically, you'll keep the master PowerScope on your desk, and you'll have several slave PowerScopes at monitoring sites in the field.

9. Communications Menu

Press the SETUP MENU key, quickly followed by the up arrow.

Use the VALUE UP/VALUE DOWN KEYS To select the communication menu.

See Chapter 8 for information on the Key Operator Menu.

See Chapter 7 for information on the 2460 PowerScope and the Storage Menu.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select a menu.

     You have three choices:

Key Operator -
     Lets you control the administra-
     tive detail of your PowerScope,
     including the clock and the
     calendar.

Communication -
     Lets you control the PowerScope
     modem and RS-232 port.

Storage -
     Lets you control the optional
     A-600 Parallel Processor.

(There is no more HELP!)

====================================
```

9. Communications Menu

Setting up the modem (internal or external)

Port: Internal Modem

Selections: Off
RS-232
External Modem
Internal Modem

Use the VALUE UP/VALUE DOWN keys to select the port you're using, in this case the Internal or External Modem. When you aren't using either the modem or the RS-232 port, select Off.

Be sure to select **Off** when you aren't using a communications port.

If you choose:

Off - Choose Off when you will not be using any communications ports.

RS-232 - Your PowerScope will send graphs and reports via the RS-232 port. See page 9-26 for instructions.

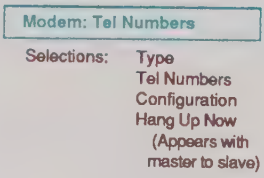
External modem - Your PowerScope will send graphs and reports via an external Hayes Smartmodem 2400 plugged into the RS-232 port.

Internal modem - Your PowerScope will send graphs and reports via its internal modem.

HELP!

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select a data communications option.

     You have four choices:

Off -
     Your PowerScope will not use
     either its RS-232 or modem ports.
     It's important to choose this
     option if you aren't making
     connection to either port.

RS-232 -
     Your PowerScope will send graphs
     and reports via the RS-232 port.

External Modem -
     Your PowerScope will send graphs
     and reports via an external Hayes
     Smartmodem 2400 plugged into the
     RS-232 port.

Internal Modem -
     Your PowerScope will send graphs
     and reports via its internal
     modem.

(There is no more HELP!)

=====================================
```

Internal or External Modem Menu



Use the VALUE UP/VALUE DOWN keys to select one of the menu sections. If beginning setup, choose Tel Numbers. The choices are explained below:

If you select:

Tel Numbers - the section that allows you to enter names and phone numbers for PowerScopes in the network will be accessed.

Type - the section that allows you to designate whether a PowerScope is a slave or a master will be accessed. Use this section when you want the *master* PowerScope to call *slaves*, and when you want to control *slave* operating parameters. This section is further explained on page 9-14.

Configuration - the section that allows you to control baud rate, dialing format (tone, pulsed or cabled), and communication standard (BELL or CCITT) will be accessed. This section is further explained on page 9-22.

Hang up now - the section that allows you to cause the *slave* to hang up and wait for the *master* to call it back will be accessed. (Another way to break connection with a slave is to put it into monitor. It will automatically hang up after a brief interval and phone back whenever it needs to print a report.) This section is further explained on page 9-24.

HELP!

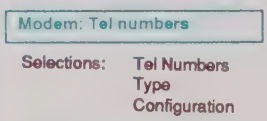
```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the section of the modem or
RS-232 menu you want to access.

     You have two RS-232 or three
modem choices:

Tel Numbers -
     You access the section where you
     enter the names and phone numbers
     for the PowerScopes on the modem
     network. (Modem only)

Type -
     You access the section where you
     designate whether the PowerScope
     is a master or slave.

Configuration -
     You access the section where you
     set parameters of the modem,
     including baud rate, dialing
     method, etc., or the baud rate
     of RS-232.

(Press HELP! again for general help
on the modem.)

=====================================
```

```
=====================================

The modem allows two PowerScopes to
communicate through a standard
telephone line. One of the PowerScopes
must be set up as a master.  A master
PowerScope can control one or more
slave PowerScopes.

Slave PowerScopes report all disturb-
ances and strip charts to their master
PowerScope.

You can use a master PowerScope to
change any setting in a slave
PowerScope remotely.

You must make entries in your
PowerScope telephone directory (Tel
Numbers) before you use the modem.

(There is no more HELP!)

=====================================
```

9 Communications Menu

Modem: Tel numbers

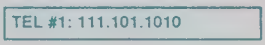
This section allows you to enter names and phone numbers for up to 8 PowerScopes in the network. If you have more than 8 PowerScopes in a network, you will have to keep track of the extra numbers and enter them in this section when you need to contact them.



Use the VALUE UP/VALUE DOWN keys to position "Modem: Tel numbers" in the display. Then press the down arrow.

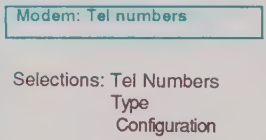
Enter up to 9 characters to name the first entry in your telephone directory. Use the left and right arrow keys to move the flashing cursor. Use the number keys to enter both letters and numbers. For example, to enter the letter A, push the '2ABC' key twice. A '2' will appear on the first push, followed by an 'A' on the second push.

Typical names are CHICAGO, SITE 23A, or HOME LAB.



Use the number keys to enter up to 34 digits for this phone number. You may enter decimal points for a two-second pause in dialing; for longer pauses put several decimal points in a row.

These questions are repeated for PowerScopes 2 through 8 in the network.



When you're finished, use the up arrow to scroll back up to the "Modem: Tel numbers" position.

HELP!

Use the VALUE UP/VALUE DOWN keys to select the section of the modem or RS-232 menu you want to access.

You have two RS-232 or three modem choices:

Tel Numbers -
You access the section where you enter the names and phone numbers for the PowerScopes on the modem network. (Modem only)

Type -
You access the section where you designate whether the PowerScope is a master or slave.

Configuration -
You access the section where you set parameters of the modem, including baud rate, dialing method, etc., or the baud rate of RS-232.

(Press HELP! again for general help on the modem.)

Enter a name for this entry in your telephone directory.

Use the left and right arrows to move the flashing cursor. Use the number keys to enter both letters and numbers; for example, to enter the letter 'K', press the '5JKL' button three times.

(Press HELP! again for general help on the modem.)

The modem allows two PowerScopes to communicate through a standard telephone line. One of the PowerScopes must be set up as a master. A master PowerScope can control one or more slave PowerScopes.

Slave PowerScopes report all disturbances and strip charts to their master PowerScope.

You can use a master PowerScope to change any setting in a slave PowerScope remotely.

You must make entries in your PowerScope telephone directory (Tel Numbers) before you use the modem.

(There is no more HELP!)

Enter the phone number for this entry in your telephone directory.

Use the number keys to enter up to 34 digits for this phone number. You can use decimal points ('.') to indicate 2-second pauses in dialing; for longer pauses, use several decimal points in a row.

(Press HELP! again for general help on the modem.)

Modem: Type

This section lets you designate whether the PowerScope that's in front of you will be a *master* or a *slave*. Because "type" can only be set when you are physically in front of the keyboard (not through use of the modem), determine ahead of time which PowerScopes in the network will be *slaves*, and which *one* will be the *master*. Setup your network with these rules in mind:

- a *master* PowerScope can call (and control) *slave* PowerScopes, and can answer calls from a *slave* PowerScope
- a *slave* PowerScope can call a *master* to transmit graphs or check that it can make connection, and can answer calls from a *master* PowerScope
- a *master* PowerScope cannot call another *master* PowerScope, and a *slave* PowerScope cannot call another *slave* PowerScope

Type: Master

Use the VALUE UP/VALUE DOWN keys to position "Type: MASTER" in the display, then press the down arrow.

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to select one of the types.

You have two choices:

Master -
This PowerScope is a master PowerScope, and will be used to control remote slave PowerScopes.

Slave -
This PowerScope is a slave PowerScope, and will be used to monitor a remote site. It will report its results to a master PowerScope.

(Press HELP! again for general help on the modem.)

==========

==========

Use the VALUE UP/VALUE DOWN keys to select the section of the modem or RS-232 menu you want to access.

You have two RS-232 or three modem choices:

Tel Numbers -
You access the section where you enter the names and phone numbers for the PowerScopes on the modem network. (Modem only)

Type -
You access the section where you designate whether the PowerScope is a master or slave.

Configuration -
You access the section where you set parameters of the modem, including baud rate, dialing method, etc., or the baud rate of RS-232.

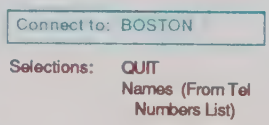
(Press HELP! again for general help on the modem.)

==========

9. Communications Menu

Type: Master

9 Communications Menu



Use the VALUE UP/VALUE DOWN keys to select the slave PowerScope you wish to call.

If you choose:

QUIT - no calls will be made. This *master* PowerScope will wait for a call from a *slave* PowerScope.

One of the names in your directory - and then press the down arrow, the *master* PowerScope will call that *slave* PowerScope. Once connection is established, the keys, display, and printer of the master PowerScope become the keys, display, and printer of the remote slave PowerScope. You can change the slave's Setup Menu, print its' Status Report, work with the slave's Report Menu, put the slave into monitor--in short, you can do just about anything you could do if the slave PowerScope were in front of you.

There will be minor delays as signals are sent back and forth, so the response to key strokes will be a little slower than you're used to. To break the connection: either 1) push the MONITOR key (the slave will send a threshold report and initial waveshapes, wait for a few minutes then hang up, and then will call back whenever it needs to print a graph), or 2) select "Modem: Hang up now" and press the down arrow. (The slave will wait for the master to call again.) See page 9-24 for further details.

HELP!

```
========================================

Use the VALUE UP/VALUE DOWN keys to
choose the slave PowerScope you want
to connect to this master PowerScope.
(The slave PowerScope must be listed
in your telephone directory - if it
isn't, go back to the Tel Numbers
option in the previous question, and
enter it in the directory.)

If you select QUIT, no connection will
be established now; however, this
master PowerScope is correctly
configured to receive calls from any
slave PowerScope.

(Press HELP! again for general help
on the modem.)

========================================
```

Type: Slave

When you want to setup a PowerScope as a *slave*:

Selections: Slave
Master

Use the VALUE UP/VALUE DOWN keys to position "Type: Slave" in the display, then press the down arrow. You can either make *slave* settings while at its' keyboard, or from the *master's* keyboard using the modem.

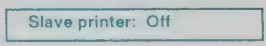
Type: Slave

Selections: None
Names (From Tel Numbers List)

Use the VALUE UP/VALUE DOWN keys to select the *master* PowerScope for this *slave* PowerScope. The slave PowerScope will call its master every time it has a report to print. (Press the down arrow to go on to the next question.)

If you choose "None", this *slave* PowerScope will expect you to call later with the name of its' *master*. Meanwhile, it will print any reports on its own printer.

Type: Slave



Selections: On
Off

Use the VALUE UP/VALUE DOWN keys to turn the *slave's* printer on or off. You will usually choose **Off**. If you do choose Off, the *slave* will phone its *master* to print reports on the *master's* printer. If you choose On, all reports will be printed both on the *master's* printer and on the *slave's* printer.

Even if you choose Off, the slave PowerScope will print its reports locally if it can't reach its master. This might happen if the master doesn't answer the phone, or if you've entered the wrong phone number. The slave will keep trying if it receives a busy signal for the master. If an A-600 is connected, set this menu item to On.

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to select one of the types.

You have two choices:

Master -
This PowerScope is a master PowerScope, and will be used to control remote slave PowerScopes.

Slave -
This PowerScope is a slave PowerScope, and will be used to monitor a remote site. It will report its results to a master PowerScope.

(Press HELP! again for general help on the modem.)

==========

==========

Use the VALUE UP/VALUE DOWN keys to choose the master PowerScope you want to use with this slave PowerScope. (The master PowerScope must be listed in your telephone directory - if it isn't, go back to the Tel Numbers option in the previous question, and enter it in the directory.)

If you select NONE, no master will be selected now; however, this slave PowerScope is correctly configured to receive calls from any master PowerScope.

(Press HELP! again for general help on the modem.)

==========

==========

Use the VALUE UP/VALUE DOWN keys to turn the printer in the slave PowerScope on or off. If you choose 'On', disturbance reports will be printed locally and sent over the modem or RS-232 to the master as well. If you choose 'Off', disturbances will just be sent over the modem or RS-232 port and will not be printed locally.

(Press HELP! again for general help on the modem)

==========

9. Communications Menu
12. Troubleshooting

Type: Slave

Hold line for: 5 minutes

Range: 0 minutes to 99 minutes

Use the number keys to enter the length of time the *slave* PowerScope should stay on the line after it has transmitted a report. Before hanging up, it will wait this length of time to see if there are any more disturbances or other reports that should be sent to the *master*. Typical values are 2 to 5 minutes.

Type: Slave

Check line now: No

Selections: No
Yes

Use the VALUE UP/VALUE DOWN keys to choose whether you want to check the telephone connection. This can be a handy test to ensure the phone lines are of adequate quality, the master's phone number has been correctly entered, etc. If you choose "Yes", this *slave* will call its *master* and verify connection.

Modem: Type

Selections: Tel Numbers
Type
Configuration

Use the up arrow to scroll back to the "Modem: Type question, then use the VALUE UP/VALUE DOWN keys to select "Modem: Configuration." Refer to page 9-22 for an explanation of how to make these settings.

HELP!

```
=====================================

Use the number keys to enter the
length of time the modem should wait
for a connection before hanging up.

The range is 1 to 60 seconds. Default
value is 15 seconds.

(Press help! again for general help
on modem.)

=====================================

=====================================

Use the VALUE UP/VALUE DOWN keys to
choose whether you want to check the
telephone connection to the master
PowerScope. If you choose 'Yes', the
slave PowerScope will call the master
PowerScope and verify the phone
number, quality of the line, etc.

(Press HELP! again for general help
on the modem.)

=====================================
```

```
=====================================

Use the VALUE UP/VALUE DOWN keys to
select the section of the modem or
RS-232 menu you want to access.

     You have two RS-232 or three
modem choices:

Tel Numbers -
     You access the section where you
     enter the names and phone numbers
     for the PowerScopes on the modem
     network. (Modem only)

Type -
     You access the section where you
     designate whether the PowerScope
     is a master or slave.

Configuration -
     You access the section where you
     set parameters of the modem,
     including baud rate, dialing
     method, etc., or the baud rate
     of RS-232.

(Press HELP! again for general help
on the modem.)

=====================================
```

9 Communications Menu

Modem: Configuration

When you want to set up a PowerScope's baud rate, dialing technique, and communication standard:

Modem: Configuration

Selections: Type
Tel Numbers
Configuration
Hang Up Now
(Appears with master to slave)

Use the VALUE UP/VALUE DOWN keys to position "Modem: Configuration" in the display, then press the down arrow.

Baud rate: 1200

Selections: 300
1200
2400

Use the VALUE UP/VALUE DOWN keys to select the baud rate for this modem. The usual value is 1200 baud. Although lower baud rates can be used with lower quality telephone lines, the PowerScope contains sophisticated error correction schemes that allow 1200 baud to be used on virtually all lines.

The PowerScope modem automatically adjusts its baud rate; if two PowerScopes are set to different baud rates, they will both adjust to the baud rate of the PowerScope that initiated the call. 2400 baud can only be used with CCITT conditioned lines. (Press the down arrow to go on to the next question.)

Dialing: Tone

Selections: Pulse
Tone
Cabled

Use the VALUE UP/VALUE DOWN keys to select the dialing technique for this modem. Pulse (or rotary) dialing works with virtually all direct-connection telephone lines. Tone (or DTMF) dialing may be required for access codes, requesting an outside line, etc. The usual answer is tone. Choose cabled for PC use (such as with a Parallel Processor and PowerTalk software).

Answer tone: BELL

Selections: BELL
CCITT

Use the VALUE UP/VALUE DOWN keys to select the communications standard you require to transmit data. The selections are BELL 212A or CCITT V.22.

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to select the section of the modem or RS-232 menu you want to access.

You have two RS-232 or three modem choices:

Tel Numbers -
You access the section where you enter the names and phone numbers for the PowerScopes on the modem network. (Modem only)

Type -
You access the section where you designate whether the PowerScope is a master or slave.

Configuration -
You access the section where you set parameters of the modem, including baud rate, dialing method, etc., or the baud rate of RS-232.

(Press HELP! again for general help on the modem.)

==========

==========

Use the VALUE UP/VALUE DOWN keys to select the baud rate for this modem. The available rates are 300, 1200, and 2400 baud. The usual choice is 1200 baud.

(Press HELP! again for general help on the modem.)

==========

==========

Use the VALUE UP/VALUE DOWN keys to select 'Pulse' (rotary) or 'Tone' (DTMF) dialing. Pulse dialing works with virtually all direct-connection telephone lines. Tone dialing may be required for access codes, requesting an outside line, etc.

Select 'Cabled' if you wish to connect your PowerScope's modem directly to another modem without using the telephone system.

(Press HELP! again for general help on the modem.)

==========

==========

Use the VALUE UP/VALUE DOWN keys to select the communications standard you require, CCITT V.22 or BELL 212A.

(Press HELP! again for general help on the modem.)

==========

9 Communications Menu

Carrier delay: 15 sec

Selections: 1 to 60 seconds

Use the number keys to enter the length of time the modem should wait for a connection before hanging up. The range is 1 to 60 seconds. The default value is 15 seconds.

Modem: Hang up

When you're on-line with a *slave* PowerScope and want it to hang up:

Modem: Hang up now

Selections: Type
Tel Numbers
Configuration
Hang up now

Use the VALUE UP/VALUE DOWN keys to position "Modem: Hang up now" in the display, then press the down arrow. The slave will hang up immediately without going into monitor mode.

HELP!

```
====================================

Use the number keys to enter the
length of time the modem should wait
for a connection before hanging up.

The range is 1 to 60 seconds. Default
value is 15 seconds.

(Press help! again for general help
on modem.)

====================================
```


9. Communications Menu

Port: RS-232

Port: RS232

Selections: RS-232
Internal modem
External modem
Off

Use the VALUE UP/VALUE DOWN keys to select Port: RS232, then press the down arrow.

RS-232: Configuration

Selections: Type
Configuration
Go Off Now (Appears with Master to Slave)

Use the VALUE UP/VALUE DOWN keys to select one of the menu sections. If beginning setup, choose Type. The choices are explained below:

If you select:

Type - the section that allows you to designate whether a PowerScope is a slave or a master will be accessed. Use this section when you want the *master* PowerScope to call *slaves*, and when you want to control *slave* operating parameters. This section is further explained on page 9-28.

Configuration - the section that allows you to control baud rate. This section is further explained on page 9-22.

Go off now - you will automatically disconnect the master from the slave. The PowerScope will confirm that you have disconnected with the message:

Slave has gone off

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to select a data communications option.

You have four choices:

Off -
Your PowerScope will not use either its RS-232 or modem ports. It's important to choose this option if you aren't making connection to either port.

RS-232 -
Your PowerScope will send graphs and reports via the RS-232 port.

External Modem -
Your PowerScope will send graphs and reports via an external Hayes Smartmodem 2400 plugged into the RS-232 port.

Internal Modem -
Your PowerScope will send graphs and reports via its internal modem.

(There is no more HELP!)

==========

==========

Use the VALUE UP/VALUE DOWN keys to select the section of the modem or RS-232 menu you want to access.

You have two RS-232 or three modem choices:

Tel Numbers -
You access the section where you enter the names and phone numbers for the PowerScopes on the modem network. (Modem only)

Type -
You access the section where you designate whether the PowerScope is a master or slave.

Configuration -
You access the section where you set parameters of the modem, including baud rate, dialing method, etc., or the baud rate of RS-232.

(Press HELP! again for general help on the modem.)

==========

9. Communications Menu

RS232: Configuration

When you want to set up a PowerScope's baud rate, dialing technique, and communication standard:

RS-232: Configuration

Selections: Type
Tel Numbers
Configuration
Go off now (will only appear if you are on line)

Use the VALUE UP/VALUE DOWN keys to position "RS232: Configuration" in the display, then press the down arrow.

Baud rate: 2400

Selections: 300
1200
2400

Use the VALUE UP/VALUE DOWN keys to select the baud rate for RS-232.

The baud rate has to be the same on the two instruments. (Press the down arrow to go on to the next question.)

HELP!

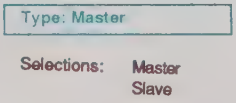
```
====================================

Use the VALUE UP/VALUE DOWN keys to
select the section of the modem or
RS-232 menu you want to access.

     You have two RS-232 or three
modem choices:

Tel Numbers -
     You access the section where you
     enter the names and phone numbers
     for the PowerScopes on the modem
     network. (Modem only)

Type -
     You access the section where you
     designate whether the PowerScope
     is a master or slave.

Configuration -
     You access the section where you
     set parameters of the modem,
     including baud rate, dialing
     method, etc., or the baud rate
     of RS-232.

(Press HELP! again for general help
on the modem.)

====================================


====================================

Use the VALUE UP/VALUE DOWN keys to
select the baud rate for this modem.
The available rates are 300, 1200, and
2400 baud. The usual choice is 1200
baud.

(Press HELP! again for general help
on the modem.)

====================================
```

RS-232: Type

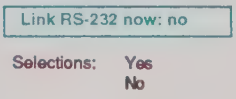
This section lets you designate whether the PowerScope that's in fron of you will be a *master* or a *slave*. Because "type" can only be set when you are physically in front of the keyboard (not through the use of an RS-232), determine ahead of time which PowerScopes in the network will be slaves, and which one will be the master. Set up your network with these rules in mind:

- a *master* PowerScope can call (and control) *slave* PowerScopes, and can answer calls from a *slave* PowerScope
- a *slave* PowerScope can call a *master* to transmit graphs or check that it can make connection, and can answer calls from a *master* PowerScope
- a *master* PowerScope cannot call another *master* PowerScope, and a *slave* PowerScope cannot call another *slave* PowerScope

Type: Master



Use the VALUE UP/VALUE DOWN keys to position "Type: MASTER" in the display, then press the down arrow.



Use the VALUE UP/VALUE DOWN keys to answer Yes or No. If you select YES, this master will hook up to a slave PowerScope through the RS-232 line.

HELP!

==========

Use the VALUE UP/VALUE DOWN keys to select one of the types.

You have two choices:

Master -
This PowerScope is a master PowerScope, and will be used to control remote slave PowerScopes.

Slave -
This PowerScope is a slave PowerScope, and will be used to monitor a remote site. It will report its results to a master PowerScope.

(Press HELP! again for general help on the modem.)

==========

==========

Use the VALUE UP/VALUE DOWN keys to select YES or NO.

If you select YES this master will connect to a slave PowerScope through the RS-232 line.

If you select NO the unit will not connect, but it will still be configured as an RS-232 master.

(There is no more HELP!)

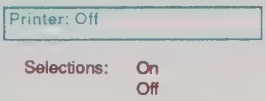
==========

9. Communications Menu

RS-232: Type

Type: Slave

Use the VALUE UP/VALUE DOWN keys to position "Type: SLAVE" in the display, then press the down arrow.



Use the VALUE UP/VALUE DOWN keys to turn the printer in the slave PowerScope On or Off.

If you choose:

On - disturbance reports will be printed locally and sent over RS-232 to the master as well.

Off - disturbance reports will be sent over the RS-232 port and will not be printed locally.

HELP!

```
====================================

Use the VALUE UP/VALUE DOWN keys to
select one of the types.

     You have two choices:

Master -
     This PowerScope is a master
     PowerScope, and will be used to
     control remote slave PowerScopes.

Slave -
     This PowerScope is a slave
     PowerScope, and will be used to
     monitor a remote site.  It will
     report its results to a master
     PowerScope.

(Press HELP! again for general help
on the modem.)

====================================
```

```
====================================

Use the VALUE UP/VALUE DOWN keys to
turn the printer in the slave
PowerScope on or off. If you choose
'On', disturbance reports will be
printed locally and sent over the
modem or RS-232 to the master as well.
If you choose 'Off', disturbances will
just be sent over the modem or RS-232
port and will not be printed locally.

(Press HELP! again for general help
on the modem)

====================================
```

9 Communications Menu

Chapter 10

Operation

1. Getting Started
2. Single-Phase Tests
3. Three-Phase Tests
4. Three-Phase Wye
5. Delta or Custom Setups
6. Probes and Accessories
7. If you have a 3460
8. Key/Operator Menu
9. Communications Menu
10. Operation
11. Loading Paper
12. Troubleshooting
13. Specifications
A. Graphs
B. Recommended Thresholds
Index
Your Comments Please

10 Operation

This chapter describes the operational functions of the PowerScope.

Refer to page iv for an overview of how to monitor power with the PowerScope.

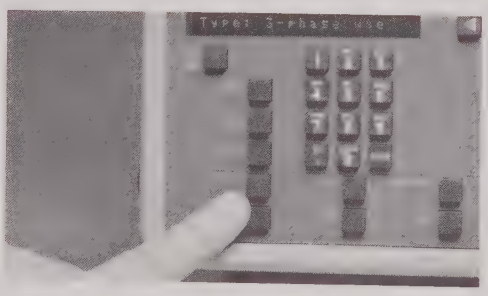
If your PowerScope starts printing graphs right after you plug it in:

These graphs are summary strip charts from the previous monitoring session.

To cancel these reports, press:
- CANCEL PRINTER
- up arrow, and
- any other function key, such as SETUP MENU.

The MONITOR Key

Press the MONITOR key to start monitoring the power line.



Pressing this key will cause the PowerScope to print a Threshold Report and initial waveshape graphs.

Next, the word MONITOR will appear on the screen, followed by the time.

Then whenever there's a disturbance, your PowerScope will print a graph of it: impulse graphs, waveshape fault graphs, and summary strip charts. These disturbance graphs are explained on page A-1.

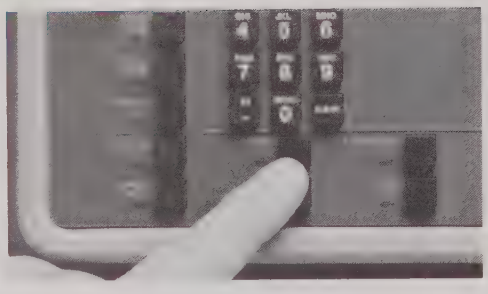
```
====================================

BMI 2400 SITE                Jan 01 1988

THRESHOLD REPORT                12:37 AM

Type:      3-phase wye

PH A-NEUT THRESHOLDS (Channel 1)
      Surge voltage:  125.0 Vrms
      Sag voltage:    105.0 Vrms
      Impulse:          200 Vpk
      High freq noise: 10.0 Vpk
      High frequency:  61.2 Hz
      Low  frequency:  58.8 Hz
      Wave shape:       20% variation
      Minimum duration: 0.1 cycles
      Line impedance:    50 ohms
      Hysteresis:      1.0%

NEUT-GND THRESHOLDS (Channel 2)
      Surge voltage:    5.0 Vrms
      Impulse:          100 Vpk
      High freq noise: 10.0 Vpk
      Line impedance:    50 ohms
      Hysteresis:      1.0%

PH B-NEUT THRESHOLDS (Sensor A)
      Surge voltage:  125.0 Vrms
      Sag voltage:    105.0 Vrms
      Impulse:          100 Vpk

PH C-NEUT THRESHOLDS (Sensor B)
      Surge voltage:  125.0 Vrms
      Sag voltage:    105.0 Vrms
      Impulse:          100 Vpk

SUMMARY REPORT INTERVAL:  Off

Internal UPS time:   5 minutes.
```

10. Operation

The STATUS Key

Press the STATUS key after you've connected to the power line and before you start monitoring to get a print-out of present voltages and frequencies.

Use the Status Report to determine if the power is live, if you've connected correctly, and to get an idea of how to set your thresholds.



```
=======================================

INTRATECH LABS                Oct 05 1988

STATUS REPORT                    11:47 AM

CHANNEL 1 (Channel 1)
   Voltage:       120.4 - 122.0 Vrms
   Frequency:      60.0 -  60.0 Hz
   Hi freq noise:   0.1 -   0.8 Vpk


NEUT-GND (Channel 2)
   Voltage:         0.1 -   0.1 Vrms
   Hi freq noise:   0.8 -   1.0 Vpk


VOLTAGE C (Sensor C)
   Voltage:       119.0 - 119.5 Vrms
   Impulse:           2 -     5 Vpk

BATTERY CONDITION
   Voltage:     10.9 Vdc
   State:       Charged

=======================================
```

The LOCK Key

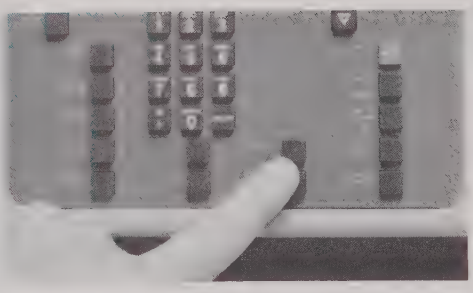
Press the LOCK key if you want to disable the keyboard against casual tampering.

Press the LOCK key then the CLEAR key to unlock the keyboard.

10. Operation

The CALIBRATION Key

Press the CALIBRATION key to get a report indicating the status of calibration.

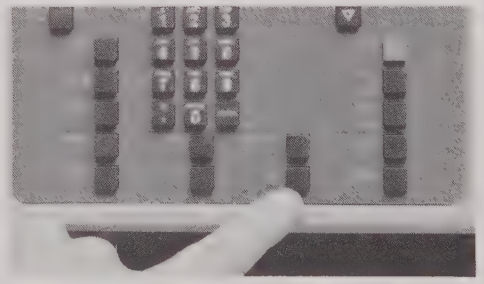


When your PowerScope is connected to a A-016 Precision Calibrator, pressing this key will cause its readings to conform to a very accurate secondary reference voltage source. You will get a report on the status of the range, noise, offset, stability, and gain for each of the PowerScope's acquisition boards.

If you press the CALIBRATION Key when your PowerScope is not connected to a Precision calibrator, you will get a report indicating what date the PowerScope was last calibrated, or a message indicating that it is currently out of calibration.

The SELF TEST Key

Press the SELF TEST key to get a report verifying the revision level of the hardware and firmware, what boards, probes and options are installed and/or supported, and a note indicating the current setting of the Communication Menu.



If there is an internal connection problem, a "not installed" message appears on this report. Refer to Chapter 12, Troubleshooting, page 12-1.

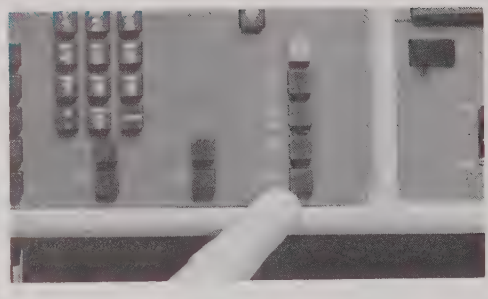
```
=====================================

BMI 2400 SITE                Aug 02 1988

CALIBRATION REPORT              4:43 PM

------- Q.A. limits imposed -------

     Calibration Module Data
-------------------------------------
Serial number:        DEMO5
Date of calibration: 04/07/88

Test station number: 04
Cal. technician:     GEORGE
Cal. board assy P/N: 83001241
Hardware rev. level: A
-------------------------------------

 Channel 1:
      Range    Noise Off-  Stab- Gain
                     set  ility
    --------- ----- ---- ----- ----
     12.5 Vrms  good good  good good
     25.0 Vrms  good good  good good
     50.0 Vrms  good good  good good
    125.0 Vrms  good good  good good
    250.0 Vrms  good good  good good
    333.0 Vrms  good good  good good
    500.0 Vrms  good good  good good
   1000.0 Vrms  good good  good good

 Channel 2:
      Range    Noise Off-  Stab- Gain
                     set  ility
    --------- ----- ---- ----- ----
     12.5 Vrms  good good  good good
     25.0 Vrms  good good  good good
     50.0 Vrms  good good  good good
    125.0 Vrms  good good  good good
    250.0 Vrms  good good  good good
    333.0 Vrms  good good  good good
    500.0 Vrms  good good  good good
   1000.0 Vrms  good good  good good

=====================================
```

```
=====================================

BMI 2400 SITE                Aug 02 1988

SELF TEST REPORT                4:43 PM

     BOARD      HARDWARE   FIRMWARE
     -----      --------   --------
     I/O        Rev. C     E0.3
     Math       Rev. F     E0.3
     Acq 1      Rev. F     E0.1
     Acq 2      Rev. F     E0.1

Envir sensor A: No probe installed
Envir sensor B: No probe installed
Envir sensor C: No probe installed
Envir sensor D: No probe installed

Options supported:
     BMI A002 Temperature Probe
     BMI A003 Temperature/Humidity Probe
     BMI A005 Proportional Supply Probe
     BMI A009 Contact Closure Probe
     BMI A111 AC/DC Voltage/Impulse Probe
     BMI A112 Current Probe
     BMI A600 Parallel Processor
     IFI EFS-3 RF Field Strength Probe

Modem is installed.

Communication port: Off.

SELF TEST PASSED.

=====================================
```

The CANCEL PRINTER Key

Press the CANCEL PRINTER key to cancel the report that is printing right now.

To cancel all pending reports, press the CANCEL PRINTER key, then immediately press the up arrow.

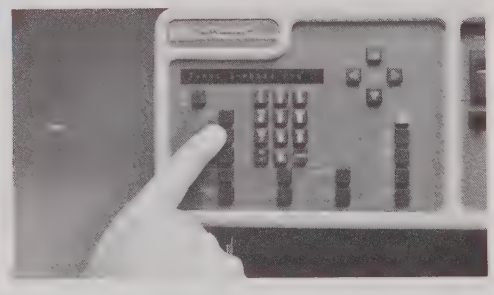


The STORE MEMORY Key

Store mem: MEMORY #1

Selections: MEMORY #1
MEMORY #2
MEMORY #3
QUIT

Press the STORE MEMORY key to store the Setup, Report, and Key Operator Menu settings in one of the PowerScope's memories.

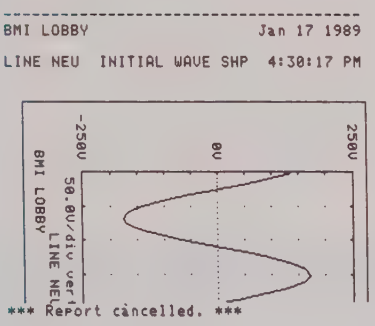


This way, you can be ready to monitor for your most common applications with just a few keystrokes.

Use the VALUE UP/VALUE DOWN keys to select which memory the setup will be stored in, then press the down arrow.

If you select QUIT nothing will be stored. If one or all of the memories is missing from the selections, it's because they are protected with a Read Only setting in the Key Operator Menu. (See page 8-24.) Naming the memories is also a function available in the Key Operator Menu.

Memories are protected even when power is removed.



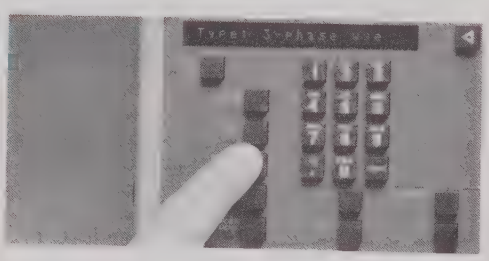
2. Single-phase
3. Dual-One Phase
4. Three-Phase Delta
5. Three-Phase Wye
6. DCP or Custom Setups
7. Probes and Accessories
8. Key Operator Menu
9. Communication Menu
10. Operation
11. Loading Paper
12. Troubleshooting
13. Specifications
A. Graphs
B. Recommended Thresholds
Index
Your Comments Please

The RECALL SETUP Key

Press the RECALL SETUP key to recall a setup from memory.

When you do this, the current Setup, Report, and Key Operator menu settings are replaced with the settings in memory. When you press the RECALL SETUP key, the display will light with:

```
Recall mem: MEMORY #1
Selections: DEFAULT
            MEMORY #1
            MEMORY #2
            MEMORY #3
            QUIT
```



Use the VALUE UP/ VALUE DOWN keys to select the memory you want recalled, then press the down arrow.

If you choose DEFAULT, all default settings for 120 VAC, 60 HZ single-phase power will be restored. If you choose QUIT, nothing will be recalled and your present setup won't be disturbed.

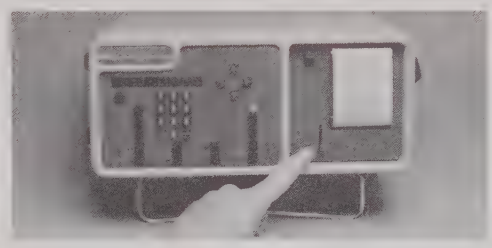
Chapter 11

Loading Paper

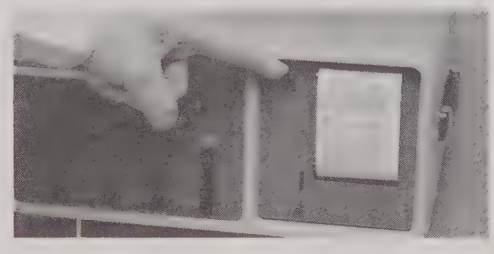
1. Single-Phase
2. Dual-Phase
3. Three-Phase Delta
4. Three-Phase Wye
5. DC or Custom Setup
6. Programmable Applications
7. Synchronizing Units
8. Key Functions Menu
9. Communications Menu
10. Operation
11. Loading Paper
12. Troubleshooting
13. Specifications
A. Graphs
B. Recommended Thresholds
Index
Your Comments Please

Your PowerScope uses a premium quality thermal paper to produce the best possible graphs from its printer. Order replacement thermal paper rolls, BMI part number S-201, from either your BMI authorized representative, or from the BMI Sales Department at (415) 570-5355. As the PowerScope begins to run out of paper, red ink appears on the edges. You will also get an "Out of paper" message on the display.

1. Move the RUN/ LOAD lever down to the LOAD position.



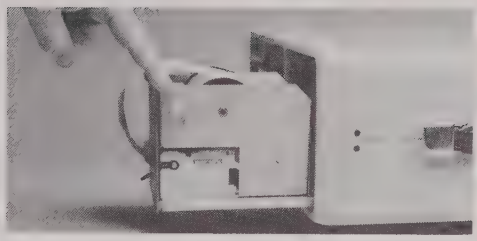
2. Open the printer door by pushing down on the door release.

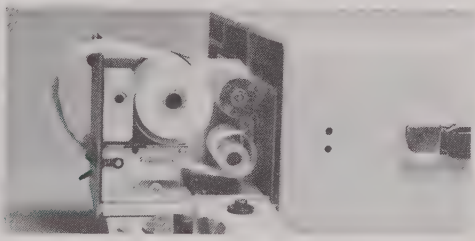


3. Slide the printer all the way out by pulling the printer door towards you.

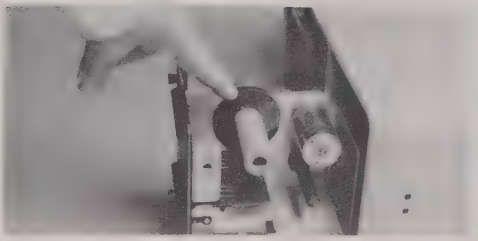
4. Open the printer's right side cover by turning the handled screw.

The cover can then drop open to expose the paper rollers.



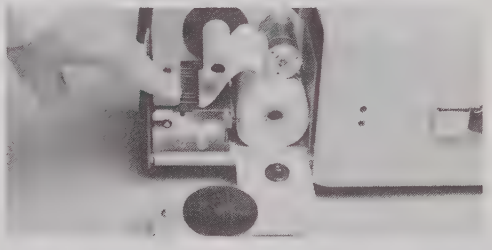


5. Take the full roll of paper off the take-up spindle, and transfer the empty cardboard spool from the load spindle to the take-up spindle. (If you have a 2460 PowerScope, ignore the instructions referring to the take-up spindle.)

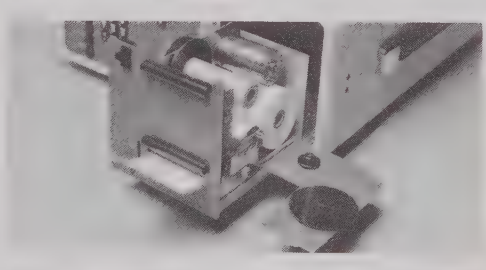


6. Put a new roll of paper on the load spindle ...

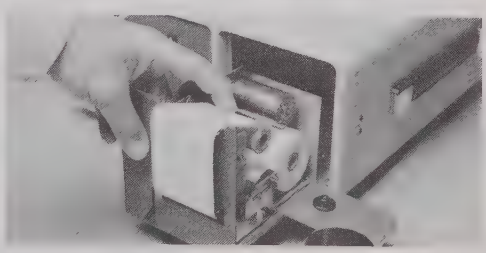
...thread it through the printer ...



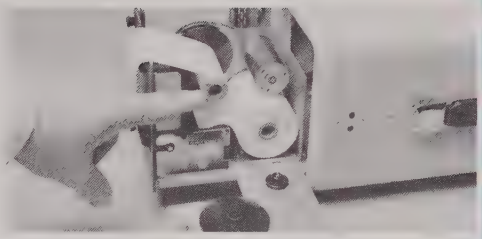
... through the slot in the printer door ...



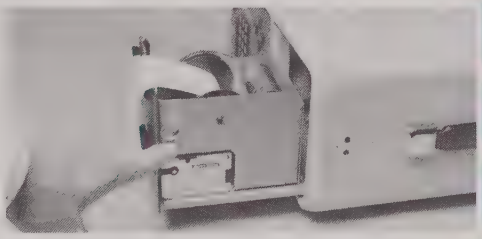
... and up and over the top edge of the printer door. (If you have a 2460 PowerScope, skip to instruction 8.)



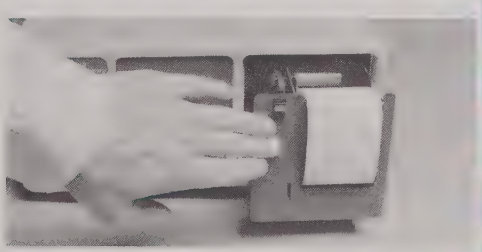
7. Tape the paper leader to the take-up spool.



8. Close the side cover, tighten the handled screw ...



...push the printer door closed ...



... and lift the RUN/ LOAD lever to the RUN position.

Chapter 12

Troubleshooting

1. Single-phase
2. Dual-One
3. Three-Phase
4. Three-Phase
5. DC in Current
6. Probes and Accessories
7. If you have a
8. Key Operator
9. Communications
10. Operation
11. Loading Paper
12 Troubleshooting
13. Specifications
A. Graphs
B. Recommended Thresholds
Index
Your Comments

Using the Troubleshooting Chart

Use the Troubleshooting Chart to narrow down the possible causes of any problem with your PowerScope. When there's a couple of possible causes, they'll both be listed with a probability. For example, if you come to a box labelled "Replace I/O Board (80%), or replace Math Board (20%), replacing the I/O Board will solve the problem eight out of ten times.

Warning
The servicing instructions in this manual are for use by qualified personnel only. To reduce the risk of electrical shock, do not perform any servicing unless you are qualified to do so.

Incoming ground: The power plug is grounded. For continued protection against risk of electrical shock and fire, do not defeat the grounded plug.

Ventilation: This unit is fan cooled. For continued protection against risk of electrical shock and possible fire hazard, do not allow the fan opening to become blocked.

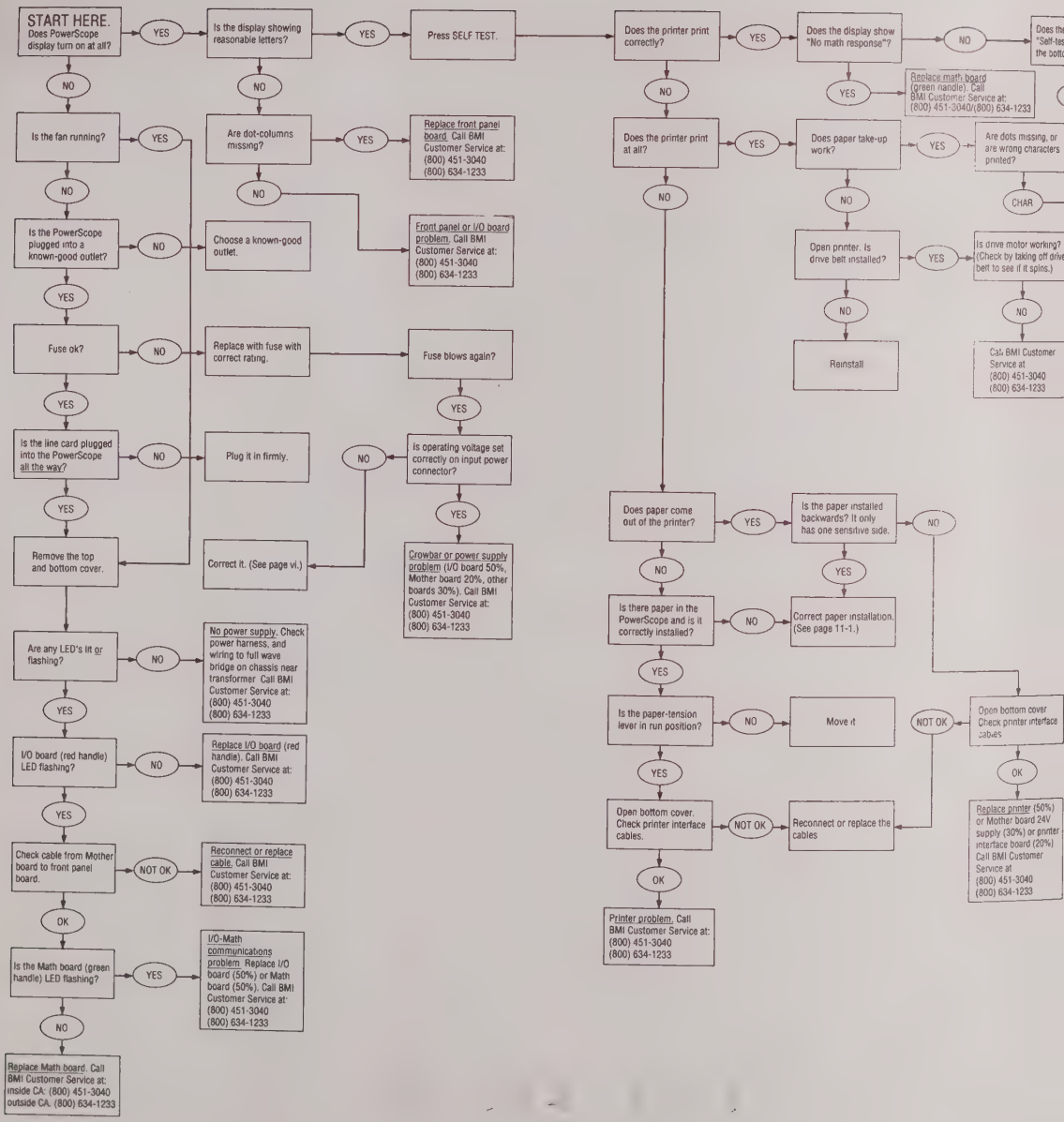
Boards and modules

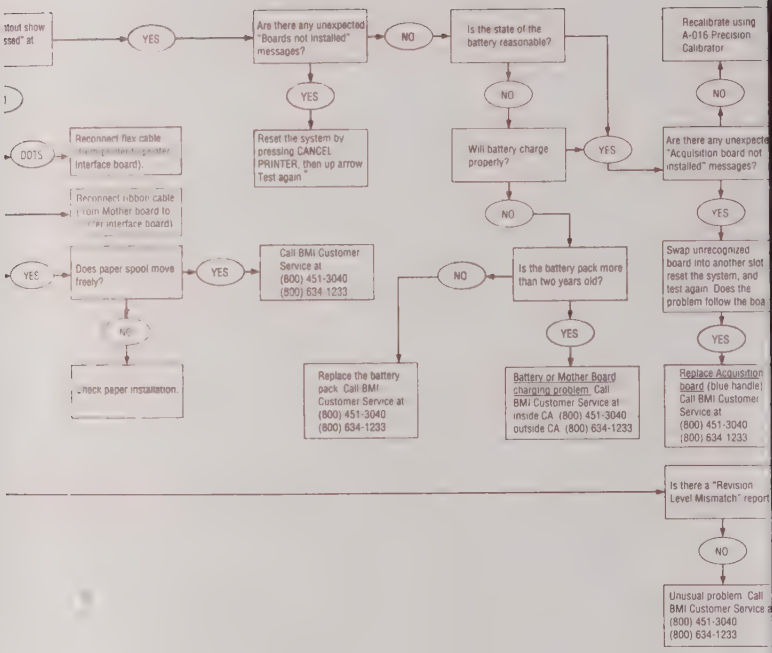
Math processor	Green handle
Acquisition processor	Blue handle
I/O processor	Red handle
Attenuator module	On rear of PowerScope; includes 2 black sockets, 2 red sockets, and 2 green sockets
Mother Board	Rectangular board in center of PowerScope, vertically mounted
Printer interface	Small rectangular board at bottom of PowerScope
Front panel board	Small 'L' shaped board, has front panel key switches

Opening your PowerScope

1. Remove the top and bottom covers by removing 12 screws, 6 on each cover. (There are 2 screws under the handle.) The covers may catch slightly under the chrome handle trim; free it gently.

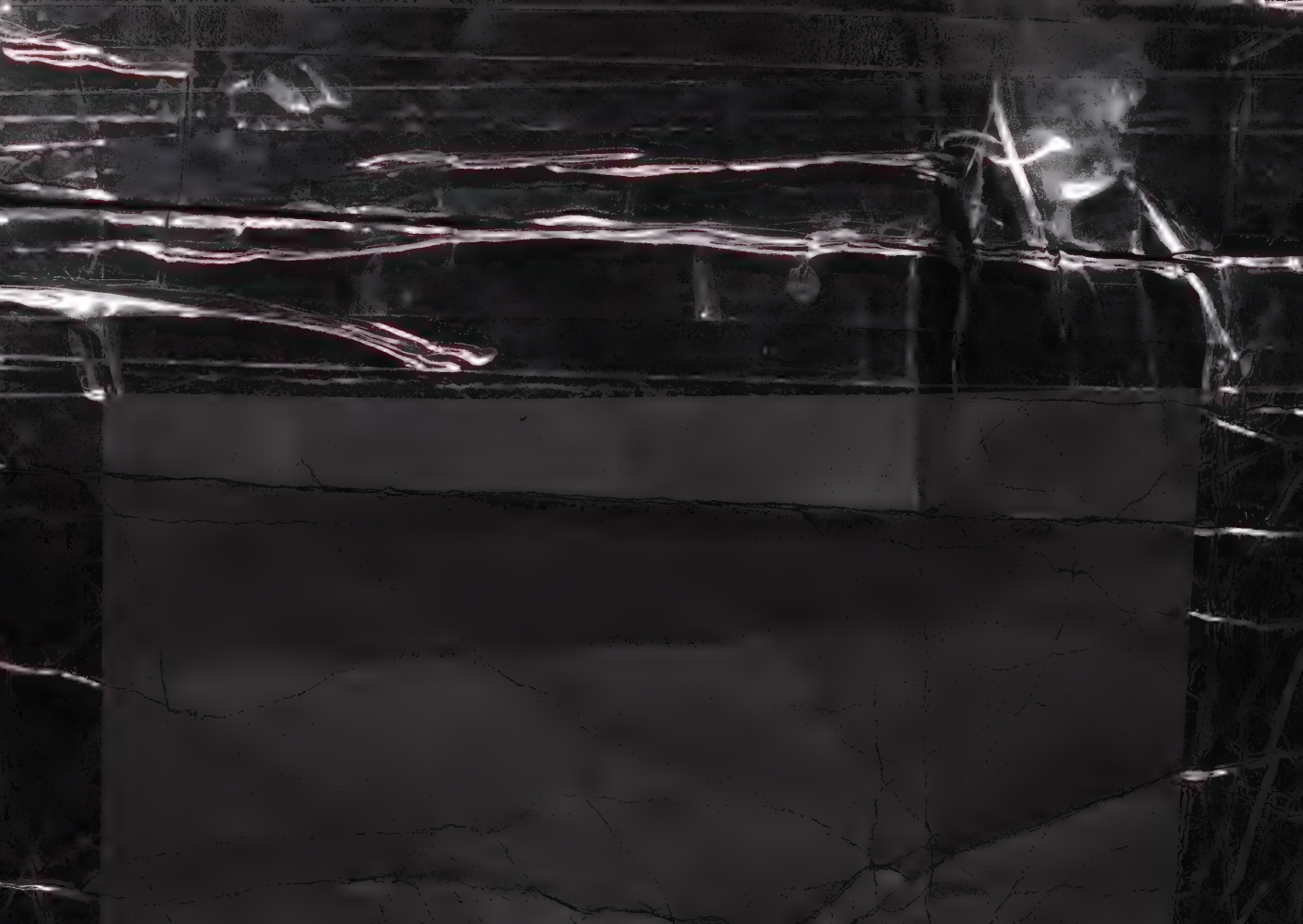
2. If necessary, remove the side wall of the chassis that holds the boards in position.

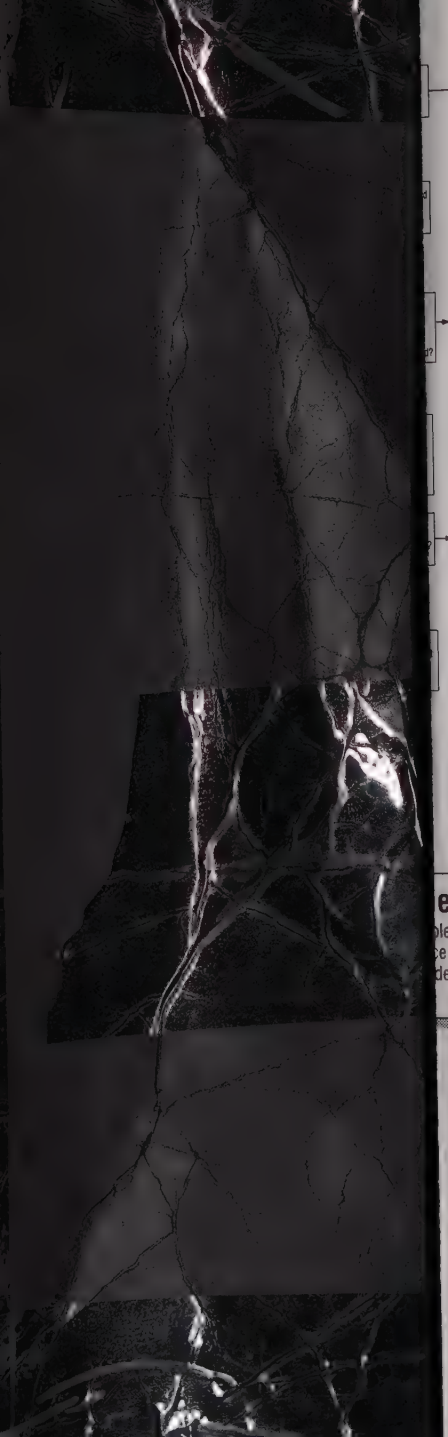

START HERE. Does PowerScope display turn on at all?
YES
Is the display showing reasonable letters?
YES
Press SELF TEST.
NO
Is the fan running?
YES
NO
Is the PowerScope plugged into a known-good outlet?
NO
Choose a known-good outlet.
YES
Fuse ok?
NO
Replace with fuse with correct rating.
Fuse blows again?
YES
Is operating voltage set correctly on input power connector?
YES
Crowbar or power supply problem (I/O board 50%, Mother board 20%, other boards 30%). Call BMI Customer Service at: (800) 451-3040 (800) 634-1233
NO
Is the line card plugged into the PowerScope all the way?
YES
Plug it in firmly.
Remove the top and bottom cover.
Correct it. (See page vi.)
Are any LED's lit or flashing?
NO
No power supply. Check power harness, and wiring to full wave bridge on chassis near transformer. Call BMI Customer Service at: (800) 451-3040 (800) 634-1233
YES
I/O board (red handle) LED flashing?
NO
Replace I/O board (red handle). Call BMI Customer Service at: (800) 451-3040 (800) 634-1233
YES
Check cable from Mother board to front panel board.
NOT OK
Reconnect or replace cable. Call BMI Customer Service at: (800) 451-3040 (800) 634-1233
OK
Is the Math board (green handle) LED flashing?
YES
I/O-Math communications problem. Replace I/O board (50%) or Math board (50%). Call BMI Customer Service at: (800) 451-3040 (800) 634-1233
NO
Replace Math board. Call BMI Customer Service at: inside CA: (800) 451-3040 outside CA: (800) 634-1233
Are dot-columns missing?
YES
Replace front panel board. Call BMI Customer Service at: (800) 451-3040 (800) 634-1233
NO
Front panel or I/O board problem. Call BMI Customer Service at: (800) 451-3040 (800) 634-1233
Does the printer print correctly?
YES
Does the display show "No math response"?
NO
YES
Replace math board (green handle). Call BMI Customer Service at: (800) 451-3040/(800) 634-1233
NO
Does the printer print at all?
YES
Does paper take-up work?
YES
Are dots missing, or are wrong characters printed?
CHAR
NO
Open printer. Is drive belt installed?
YES
Is drive motor working? (Check by taking off drive belt to see if it spins.)
NO
Reinstall
NO
Call BMI Customer Service at (800) 451-3040 (800) 634-1233
NO
Does paper come out of the printer?
YES
Is the paper installed backwards? It only has one sensitive side.
NO
YES
NO
Is there paper in the PowerScope and is it correctly installed?
NO
Correct paper installation. (See page 11-1.)
YES
Is the paper-tension lever in run position?
NO
Move it
NOT OK
Open bottom cover. Check printer interface cables.
OK
Replace printer (50%) or Mother board 24V supply (30%) or printer interface board (20%). Call BMI Customer Service at (800) 451-3040 (800) 634-1233
YES
Open bottom cover. Check printer interface cables.
NOT OK
Reconnect or replace the cables
OK
Printer problem. Call BMI Customer Service at: (800) 451-3040 (800) 634-1233

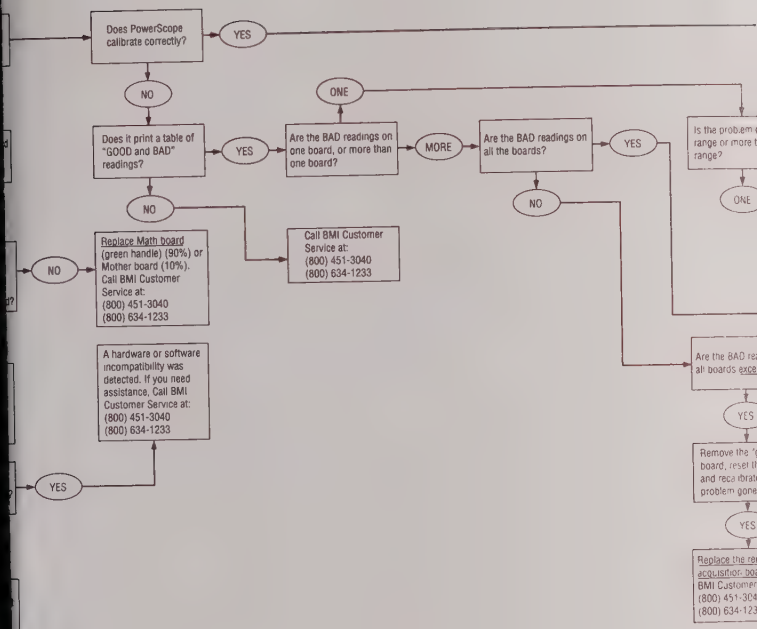

YES
Are there any unexpected "Boards not installed" messages?
NO
Is the state of the battery reasonable?
Recalibrate using A-016 Precision Calibrator
YES
NO
NO
DOTS
Reconnect flex cable
Interface board).
Reset the system by pressing CANCEL PRINTER, then up arrow Test again.
Will battery charge properly?
YES
Are there any unexpected "Acquisition board not installed" messages?
Reconnect ribbon cable
NO
YES
YES
Does paper spool move freely?
YES
Call BMI Customer Service at (800) 451-3040 (800) 634-1233
NO
Is the battery pack more than two years old?
Swap unrecognized board into another slot reset the system, and test again. Does the problem follow the boa
NO
YES
YES
Check paper installation.
Replace the battery pack. Call BMI Customer Service at (800) 451-3040 (800) 634-1233
Battery or Mother Board charging problem. Call BMI Customer Service at inside CA (800) 451-3040 outside CA (800) 634-1233
Replace Acquisition board (blue handle) Call BMI Customer Service at (800) 451-3040 (800) 634-1233
Is there a "Revision Level Mismatch" report
NO
Unusual problem. Call BMI Customer Service a (800) 451-3040 (800) 634-1233

PowerScope Troubl

Use this chart to narrow down the possi
PowerScope. Call BMI's Customer Servi
Phone: inside CA (800) 451-3040 / outsi
TWX: 910-374-3059



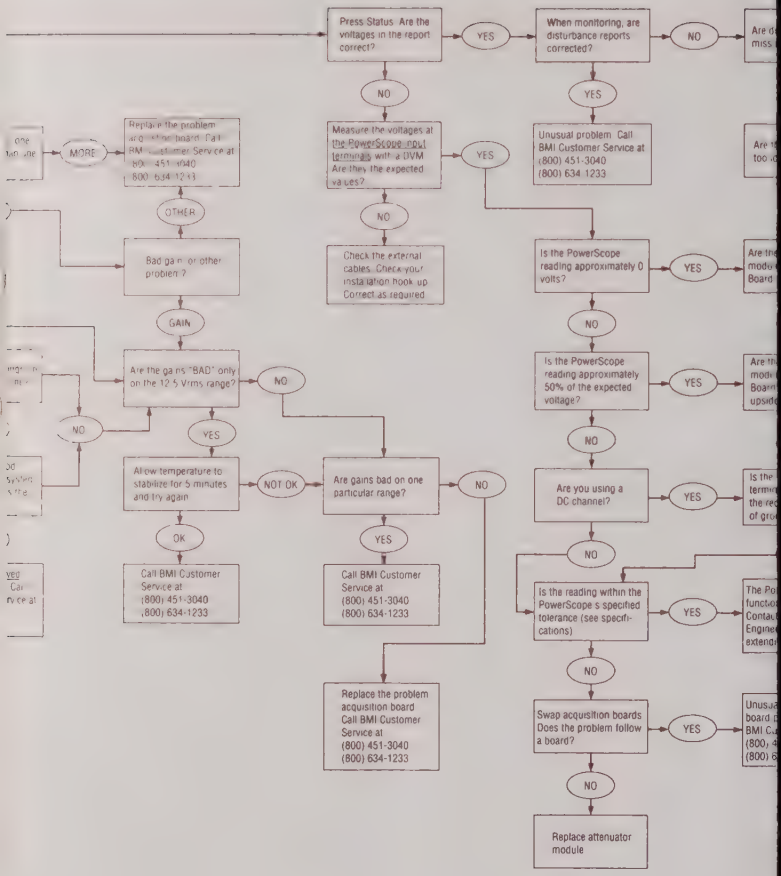


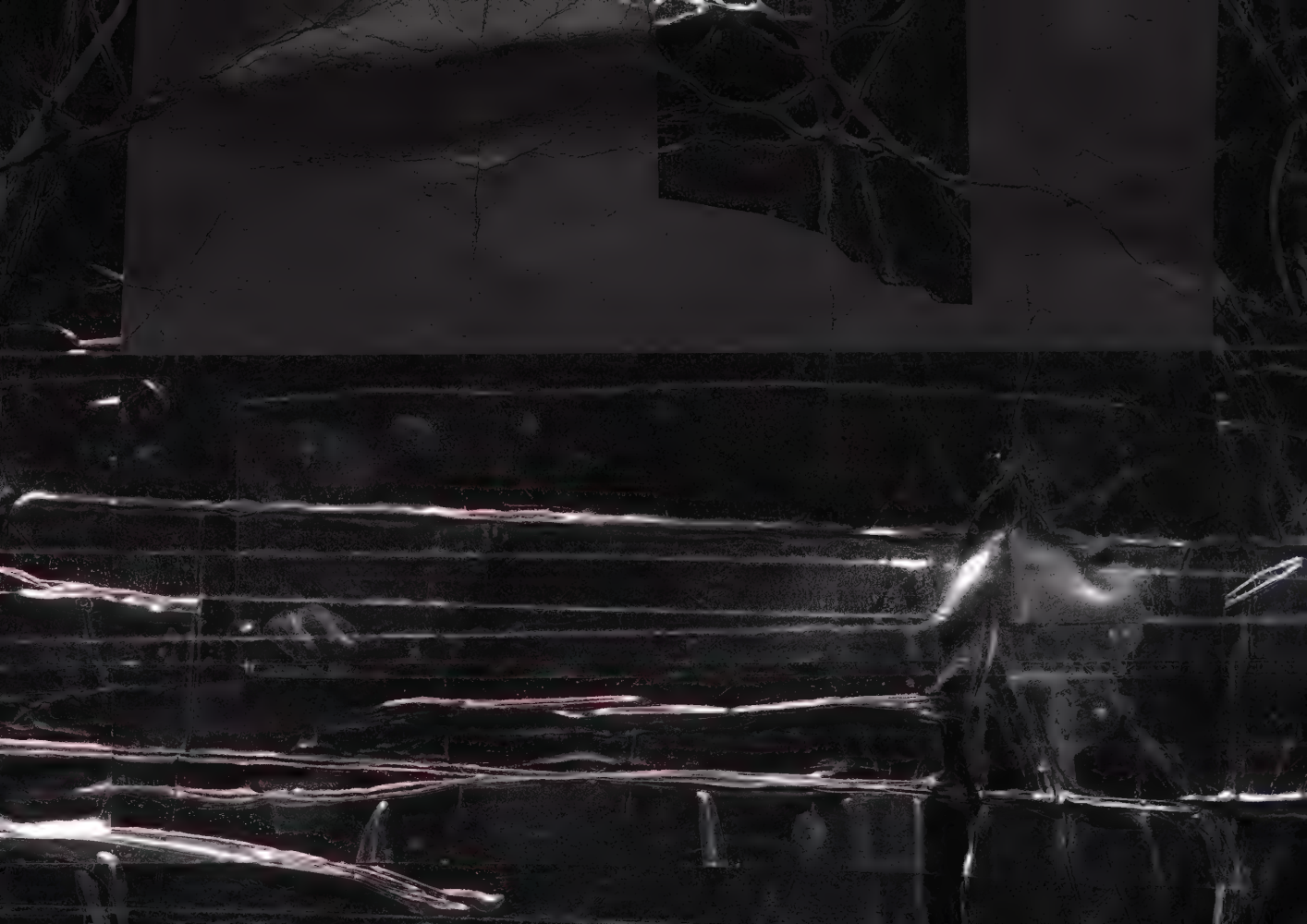

Does PowerScope calibrate correctly?
YES
NO
Does it print a table of "GOOD and BAD" readings?
YES
NO
Are the BAD readings on one board, or more than one board?
ONE
MORE
Are the BAD readings on all the boards?
YES
NO
Replace Math board (green handle) (90%) or Mother board (10%). Call BMI Customer Service at: (800) 451-3040 (800) 634-1233
Call BMI Customer Service at: (800) 451-3040 (800) 634-1233
A hardware or software incompatibility was detected. If you need assistance, Call BMI Customer Service at: (800) 451-3040 (800) 634-1233

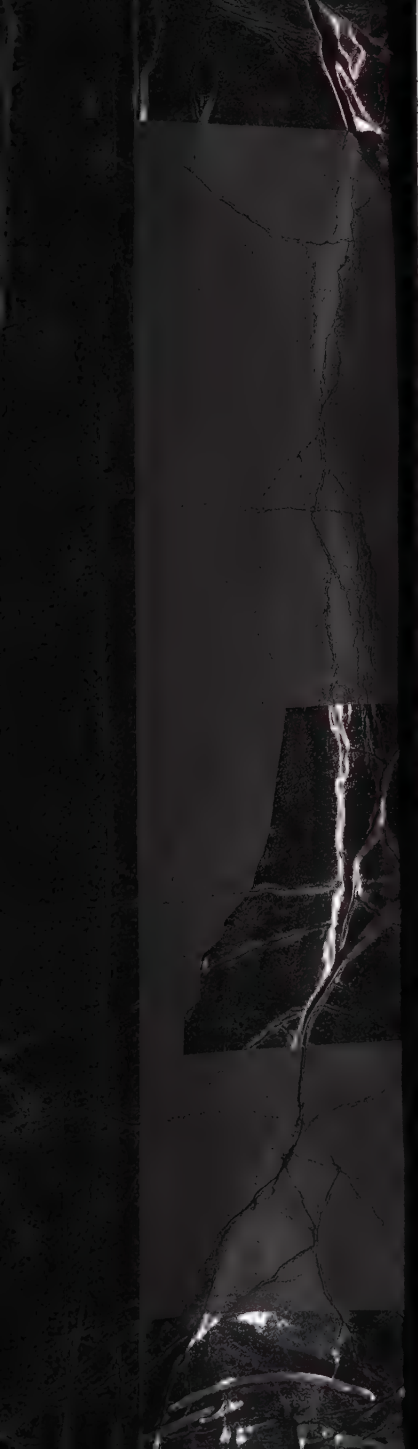
eshooting Chart

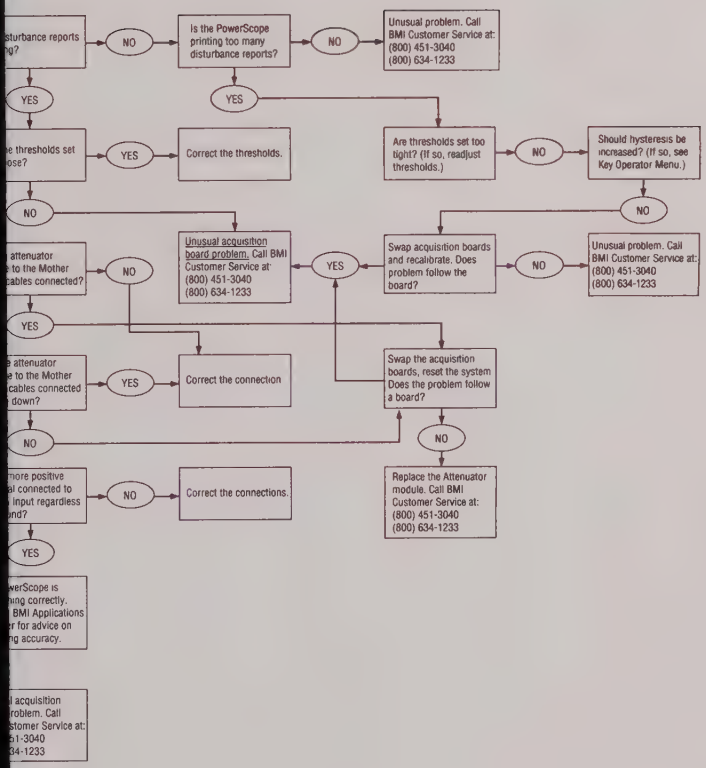
ble causes of any problem with your
ce Department if you need help:
de CA (800) 634-1233

355


Press Status. Are the voltages in the report correct?
YES
When monitoring, are disturbance reports corrected?
NO
NO
YES
MORE
Replace the problem acquisition board. Call BMI Customer Service at (800) 451-3040 (800) 634-1233
Measure the voltages at the PowerScope input terminals with a DVM. Are they the expected values?
YES
Unusual problem. Call BMI Customer Service at (800) 451-3040 (800) 634-1233
OTHER
NO
Bad gains or other problem?
Check the external cables. Check your installation hook-up. Correct as required.
Is the PowerScope reading approximately 0 volts?
YES
GAIN
NO
Are the gains "BAD" only on the 12.5 Vrms range?
NO
Is the PowerScope reading approximately 50% of the expected voltage?
YES
NO
YES
NO
Allow temperature to stabilize for 5 minutes and try again
NOT OK
Are gains bad on one particular range?
NO
Are you using a DC channel?
YES
OK
YES
NO
Call BMI Customer Service at (800) 451-3040 (800) 634-1233
Call BMI Customer Service at (800) 451-3040 (800) 634-1233
Is the reading within the PowerScope's specified tolerance (see specifications)
YES
NO
Replace the problem acquisition board. Call BMI Customer Service at (800) 451-3040 (800) 634-1233
Swap acquisition boards. Does the problem follow a board?
YES
NO
Replace attenuator module






sturbance reports
g?
NO
Is the PowerScope printing too many disturbance reports?
NO
Unusual problem. Call BMI Customer Service at: (800) 451-3040 (800) 634-1233
YES
YES
e thresholds set ose?
YES
Correct the thresholds.
Are thresholds set too tight? (If so, readjust thresholds.)
NO
Should hysteresis be increased? (If so, see Key Operator Menu.)
NO
NO
attenuator e to the Mother cables connected?
NO
Unusual acquisition board problem. Call BMI Customer Service at: (800) 451-3040 (800) 634-1233
YES
Swap acquisition boards and recalibrate. Does problem follow the board?
NO
Unusual problem. Call BMI Customer Service at: (800) 451-3040 (800) 634-1233
YES
e attenuator e to the Mother cables connected down?
YES
Correct the connection
Swap the acquisition boards, reset the system Does the problem follow a board?
NO
NO
more positive al connected to input regardless end?
NO
Correct the connections.
Replace the Attenuator module. Call BMI Customer Service at: (800) 451-3040 (800) 634-1233
YES
werScope is ning correctly. BMI Applications r for advice on ng accuracy.
l acquisition roblem. Call stomer Service at: 51-3040 34-1233

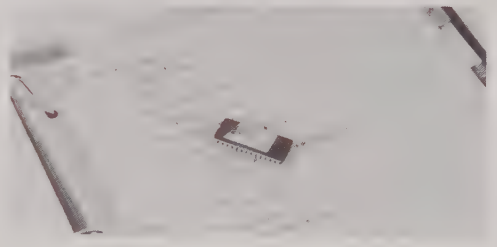
Chapter 13

Specifications

The 2400 PowerScope combines 8 digital oscilloscopes, 16 true RMS voltmeters, 2 frequency meters, 2 noise meters, and up to 8 strip-chart recorders in a compact, lightweight package. All of these instruments are designed for power and environmental recording; front panel controls set the triggering thresholds and control the configuration of the instruments.

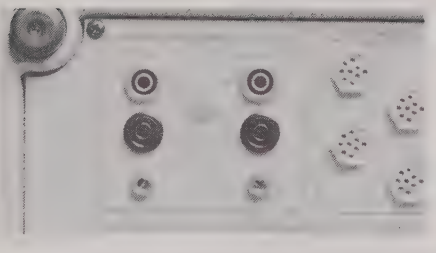
Voltages at the inputs are stepped down by the **Attenuator Module**, then analyzed by the **Acquisition Processors**, which require periodic calibration by the **Precision Calibrator**. When an Acquisition Processor detects a disturbance, it passes the raw disturbance data to the **Mathematics Processor**, which analyzes it and sends it to the **I/O Processor**. The final result is sent to the **Printer Interface**, which then sends it to be printed on the **Printer**.

Software



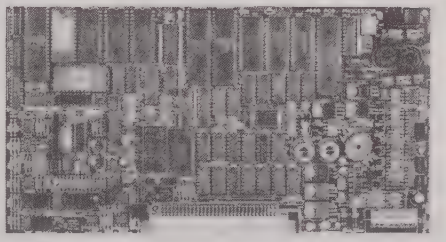
There are four Z-80 microprocessors in each 2400 PowerScope being driven by more than 30,000 lines of code. (Two high-speed custom processors run hard-wired sequences.) The software is stored in EPROM's. Each Z-80 runs an identical real-time, multi-tasking, bank-switching operating system. This operating system controls up to 30 tasks which run simultaneously on each processor, with carefully ranked priority. The operating system also allows critical events to bypass the usual scheduling controls, and tasks can activate and deactivate themselves or other tasks as required. The software is written in "C" and assembly language.

Attenuator Module



The Attenuator Module accepts high-voltage inputs (up to 600 Vrms, or 6,000 volt impulses) and attenuates them by a factor of 2,048:1. Attenuation for each channel occurs in a separate Faraday-shielded compartment; the differential output is sent through a shielded twisted-pair cable directly to the input of an Acquisition Processor.

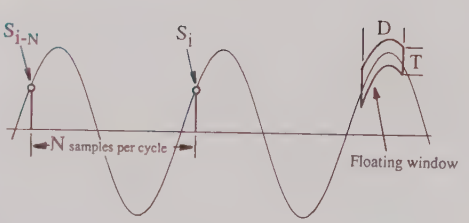
Acquisition Processor



The two Acquisition Processors have blue handles and blue labels on their EPROM's. Each Acquisition Processor is responsible for measuring one channel and two probe inputs. On its assigned input channel, each Acquisition Processor monitors waveshape, true RMS voltage, impulses, frequency, and high-frequency noise. On each assigned probe input, each Acquisition Processor monitors one code voltage that identifies the probe, and two signal voltages. An Acquisition Processor can report on the status of any of its instruments at the request of the Mathematics Processor, or the Mathematics Processor can send thresholds to the Acquisition Processor, which causes the Acquisition Processor to automatically send reports when the thresholds are exceeded. The Mathematics Processor can also configure the Acquisition Processor by setting its RMS voltage range, impulse full-scale range, frequency cut-offs on its filters, input source, sampling rates, etc. Each of the Acquisition Processors has queue memory for about 10 graphs.

Waveshape Fault Detection

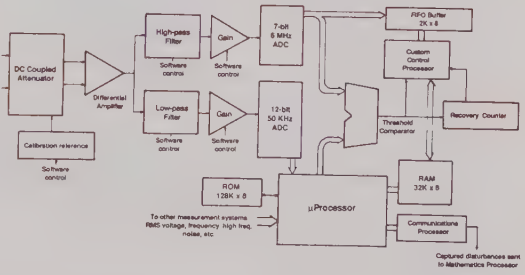
The 2400 PowerScope uses a patented digital technique to detect changes in the shape of the voltage waves that it monitors. The technique is described more fully in a technical paper, available from BMI, titled **A Floating-window Algorithm for Detecting Certain Power Faults That Disrupt Sensitive Electronic Loads.**



Basically, the technique digitally samples the waveform, and compares the samples for each cycle to the corresponding samples in the previous cycle. If the samples differ by more than a threshold value (the tolerance) for a threshold length of time (the duration), a waveshape fault graph will be printed. This technique readily identifies sub-cycle drop-outs, addition or removal of substantial harmonic distortion, switching to or from a non-sinusoidal power source, and so on.

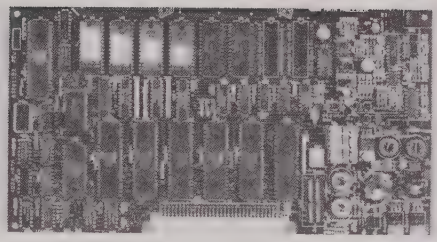
Impulse Capture

The 2400 PowerScope uses a patented digital system for detecting, capturing, and analyzing impulses on the power line. This system is described more fully in a technical paper, available from BMI, titled **A System for Capturing and Presenting Short-duration Voltage Impulses on AC Power Lines.**



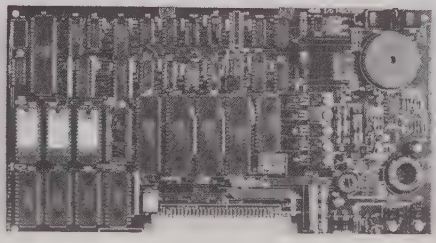
Basically, the incoming signal is split into high-frequency and low-frequency components. The low-frequency component is digitally sampled at approximately 5 KHz, and the high-frequency component is digitally sampled at approximately 2.0 MHz (500 nanoseconds). If an impulse appears in the high-frequency section in excess of the user's threshold, pre-trigger and post-trigger samples are captured in both sections for analysis. In a process called decimation, the samples in the high-speed section are examined, and the horizontal display window is adjusted for the best resolution for that particular impulse. The full-scale vertical values for both sections are controlled by software.

Mathematics Processor



The Mathematics Processor has a green handle and green labels on its EPROM's. It is at the center of all the processing in the PowerScope: it is responsible for all of the non-volatile memory, the Set-up and Report Menus, the clock and calendar, and the self-calibration tables.
It has queue memory for about 30 graphs. While the instrument is monitoring, the Mathematics Processor periodically requests data from the Acquisition Processors for the strip charts and summary strip chart reports. It also accepts asynchronous raw disturbance reports from the Acquisition Processors; when these reports arrive, the Mathematics Processor performs any necessary math operations on them, scales and formats them, and passes them on to the I/O Processor. The Mathematics Processor is also responsible for testing the complete instrument, and it compiles the Self Test Report.

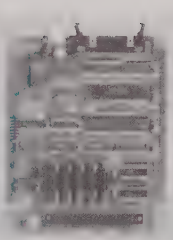
I/O Processor



The I/O Processor has a red handle and red labels on its EPROM's. It is responsible for communicating with the printer interface, the front panel, and the Mathematics Processor (note that the RS-232 port and the modem both talk directly to the Mathematics Processor, not the I/O Processor). It also performs a basic test of the Mathematics Processor when the SELF TEST key is pressed (the Mathematics Processor tests the rest of the instrument). It also holds all of the HELP! messages in all the languages, and has queue memory for about 15 graphs.

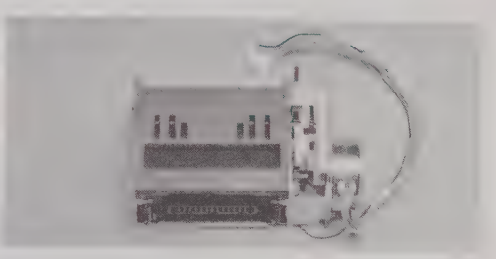
Printer Interface

The printer interface board accepts 8-bit parallel characters from the I/O processor, and requires +5V (from the I/O processor to drive the board's local logic) and +24V (from the Mother Board to drive the thermal print head). It controls the printer-advance motor and turns the thermal print elements on and off.



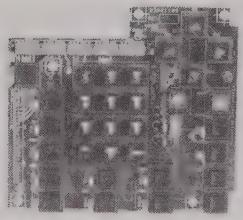
Printer

The printer connects directly to the printer interface board through a flexible circuit connector (for the print-head thermal elements and sensors) and a twisted wire pair (for the paper advance motor). The printer has a minimum number of moving parts - the printer head doesn't move - so it is remarkably reliable. A clever thermal strategy allows crisp, clear printing. To maintain print quality you must use the recommended thermal paper.



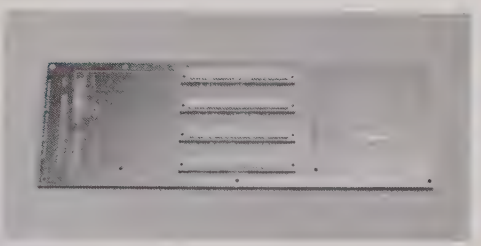
Front Panel

The Front Panel board connects through a 25-wire cable to the Mother Board, where all of the connections are routed directly to the I/O Processor. The Front Panel uses +5V from the I/O Processor. Data for the 20-character display is fed serially for the first 7-dot-column for each of the 20 characters, then displayed, then data for the second dot-column for each of the 20 characters is fed serially and displayed, etc. The keyboard uses a matrix strategy, with the first key depression causing an interrupt. There is 0-key rollover.



Mother Board

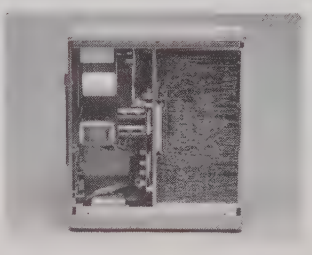
The Mother Board contains sockets for the other boards. In addition to connecting all of the other boards, it provides filtering, clamping, and crowbarring for the raw DC supply, and generates 24 Vdc for the printer and battery charging circuits. The battery charger and the battery switching relay are also on the Mother Board.



Power Supply

The PowerScope can use three sources of power: AC power, internal NiCad batteries, or an external 12-Vdc supply, such as an automobile battery. Unlike older technology monitors, the AC input power is not connected to any impulse suppression devices, so the instrument can be powered from the same line it is monitoring without affecting the validity of the information. The input AC power feeds a specially constructed toroidal power transformer with 6kV of isolation between any input terminal and ground. Additional shielding is provided to isolate the input of the transformer and the output. The output feeds a simple linear supply; the output of this supply is filtered, then paralleled with the NiCad batteries, then becomes the raw DC supply for the instrument. The raw DC is fed to switching supplies located on each processor board. For analog circuits, these switching supplies feed linear regulators. All power is distributed on power and ground planes; four-layer circuit boards are used throughout. Ground mecca is located at a fast-on terminal on the Mother Board near the rear of the I/O Processor.

Mechanical



The PowerScope was designed from the beginning as a field service instrument; the size constraint was set by what would fit under an airline seat, and the anticipated shock and vibration level was set by the trunk of a rental car. Rugged cast-aluminum front and rear bezels are coupled with extensive internal bracing and clamping. External parts are finished with two-part polyurethane; internal parts are anodized.

The Precision Calibrator

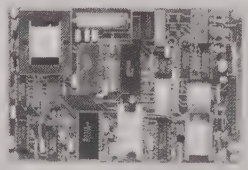
The 2400's optional A-016 Precision Calibrator contains an extremely stable band-gap zener voltage reference, and a laser-trimmed voltage selection array. It is used to provide many different reference voltages which are used to calibrate the instruments on the Acquisition Processors. The Precision Calibrator includes a calibration EPROM, which contains both a table of corrections for that particular Precision Calibrator and the calibration tracing information. The Precision Calibrator, if it has successfully calibrated an Acquisition Processor, causes the BMI logo to be placed at the lower corner of each graph generated by that channel. The Precision Calibrator is designed to be used in the field.

BMI part number A-016 Precision Calibrator.

Modem

The optional Modem is an autodial, auto-answer, auto-speed modem that operates from 300 baud to 1200 baud. Two RJ-11 jacks are provided, so standard telephone service can be continued when the modem is not using the telephone line.

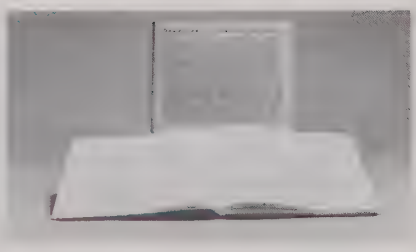
Operation of the modem is described on page 9-2.



BMI Model number G-006 Auto Dial/Auto Answer 300/1200-Baud Internal Modem.

13. Specifications

The Handbook of Power Signatures (model A-010), is a reference book collecting the experience of leading power experts. It contains over one hundred PowerScope disturbance graphs annotated with their Identifying Features, Cause, Symptoms, and Solutions. You can flip through the pages, match your disturbance graph to one in the book, and find the cause and solution to your problem simply stated.



Waveshape fault - power factor correction

Identifying features

The waveshape shows a damped ringing that decays over the course of a fraction of a cycle to a few cycles. The ringing may occur at frequencies from about 200 Hz to about 1 kHz (although at the upper limit it is more likely to be observed as an impulse). The ringing always initially moves towards the zero line. On three-phase systems, similar waveshape faults may be observed simultaneously on two of the phases, but rarely three.

Cause

A power factor correction capacitor was switched on line. Generally, the lower the frequency of the ringing, the further up the distribution system the switch occurred. The ringing moves towards the zero line because the discharged capacitor initially appears as a high current load to the distribution system.

Symptoms

Sensitive electronic loads may be disrupted. Power-on reset circuits may be triggered unexpectedly.

Power factor correction capacitors are generally switched on as inductive loads are added; typically, this will occur as manufacturing processes are started up. Consequently, this type of disturbance occurs most frequently early in the morning on weekdays. (However, it can occur at any time. Some power factor correction capacitors are switched manually, and some are automatically switched as inductive loads are brought on line.)

Solutions

If sensitive loads are being disrupted, consider contacting the utility for assistance.

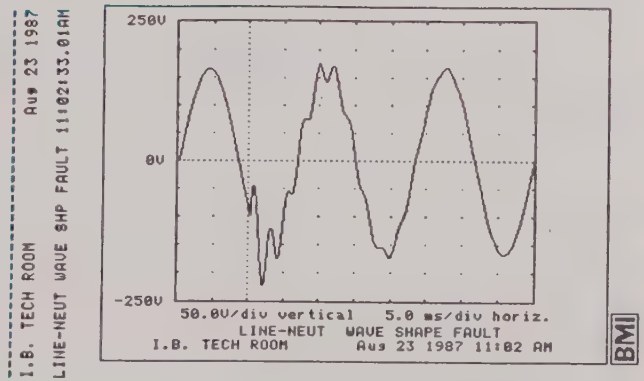
It is impractical to eliminate the cause of this disturbance, so a mitigating device must be selected.

Isolation transformers and line filters generally are ineffective against disturbances which have frequency content low enough that they appear as waveshape faults rather than impulses.

Ferroresonant transformers will generally eliminate this disturbance, but may interact with other conditioning devices.

Motor generator sets and UPS systems will eliminate this disturbance.

Waveshape fault - power factor correction



Related to

High frequency model of power line, page 26
Impulse - utility power factor correction (I), page 94
Impulse - utility power factor correction (II), page 96

Contrast with

Waveshape fault - out-of-phase source, page 68

Input

2 identical, independent acquisition channels. Each channel can be used for AC, DC, or neutral-to-ground measurements.

AC Measurements

Impedance: 4.0 Megohms min., 70 pF max.
Type: Floating differential
Maximum input: 6,400 volts for 1 millisecond, 600 Volts continuous
Common mode rejection: 70 dB @ 100 KHz

AC Impulses

Input Range	Available Full-Scale Ranges	Typical Accuracy	Maximum Deviation
20 Vpk - 6,400 Vpk	100 Vpk 200 Vpk 400 Vpk 800 Vpk 1,600 Vpk 3,200 Vpk 6,400 Vpk	±3% of reading ±2% of full-scale	5% of reading @300 Vpk w/ 1/2 cycle of 25 KHz superimposed on 120VAC, 60Hz

Input filter: High-pass, 2-pole, 500 Hz (3 dB point) at 50Hz, 60Hz nominal
High-pass, 2-pole, 5 KHz (3 dB point) at 400 Hz nominal
Sampling frequency: 2.0 MHz
Aperture: 0.02 nanoseconds
Display window: 128.0 µseconds, 256.0 µseconds, 512.0 µseconds, or 1.024 milliseconds (software selected after impulse has been captured)

AC Waveshape Faults

Displayed parameters: phase position, calculated energy, rise time, peak voltage

Input Range	Available Full-Scale Ranges
45.0 Hz - 450.0 Hz	Same as RMS voltages

Input filter: Low-pass, 2-pole, 10KHz (3 dB point)
Resolution: Selectable, 0.5 ms/division or 12.5 ms/division
Sampling rate: 2,048 Hz normal resolution; 5,120 Hz high resolution
Detection algorithm: floating-window
Look-back distance: Locked to frequency measurement
Tolerance threshold: User-supplied 1.0% - 99.9% of full scale
Duration threshold: User-supplied; 0.1 cycles - 9.9 cycles

AC RMS Voltages

Sampling rate: 12.8 Hz
Input filter: Low-pass, 2-pole, 10 KHz (3 dB point)
Conversion: True RMS, 100 ms time constant
Threshold hysteresis: User-selected, 0.0% - 5.0%

Input Range	Available Full-Scale Ranges	Typical Accuracy	Maximum Deviation
1.0Vrms - 750.0Vrms	12.5 Vrms 25.0 Vrms 50.0 Vrms 125.0 Vrms 250.0 Vrms 333.0 Vrms 500.0 Vrms 1000.0 Vrms	±0.5% of reading ±0.1Vrms	±1% @120 Vrms, 60 Hz

AC Frequency

Input Range	Available Full-Scale Ranges	Typical Accuracy
45.0 Hz - 450.0 Hz	Adjusted by user-supplied thresholds	±0.1% of reading

Input filter: Low-pass, 2-pole, 10KHz (3 dB point)
Conversion: Digitally integrated for 32 cycles
Output filter: Digital 5-point Bartlett filter

AC High Frequency Noise

Input Range	Available Full-Scale Range	Typical Accuracy	Maximum Deviation
3.0 - 20.0 Vpk-to-pk	20 Vpk-to-pk	±5% of reading ±1.0V	±1.0V @10.0V @100KHz superimposed on 120VAC, 60Hz

Input filter: High-pass, 4-pole Butterworth, 10 KHz (3 dB point)
Conversion: Peak detector w/ 100 milliseconds integration
Sampling rate: 12.8 Hz

DC Measurements

DC Voltages

Input Range	Available Full-Scale Ranges	Typical Accuracy	Maximum Deviation
1.0 Vdc - 750.0 Vdc	12.5 Vdc 25.0 Vdc 50.0 Vdc 125.0 Vdc 250.0 Vdc 333.0 Vdc 500.0 Vdc 1000.0 Vdc	±0.5% of reading ±0.1 Vdc	± 0.1 Vdc

Sampling rate: 12.8 Hz
Input filter: Low-pass, 2-pole, 10 KHz (3 dB point)
Conversion: True RMS, 100 ms time constant
Threshold hysteresis: User-selected, 0.0% - 5.0%

DC Waveshape Faults

Input filter: Low-pass, 2-pole, 10KHz (3 dB point)
Resolution: Selectable, 0.5 ms/division or 12.5 ms/division
Sampling rate: 2,048 Hz normal resolution; 5,120 Hz high resolution
Detection algorithm: Floating-window
Look-back distance: Fixed, 5 milliseconds
Tolerance threshold: User-supplied, 1.0% - 99.9% of full-scale
Duration threshold: Fixed, 1 millisecond

DC Impulses

Input Range	Available Full-Scale Ranges	Typical Accuracy	Maximum Deviation
20 Vpk - 6,400 Vpk	100 Vpk 200 Vpk 400 Vpk 800 Vpk 1,600 Vpk 3,200 Vpk 6,400 Vpk	±3% of reading ±2% of full-scale	Same as AC

Input filter: High-pass, 2-pole, 500 Hz (3 dB point)
Sampling frequency: 2.0 MHz
Aperture: 0.02 nanoseconds
Display window: 128.0 µseconds, 256.0 µseconds, 512.0 µseconds, or 1.024 milliseconds (software selected after impulse has been captured)

Displayed parameters: calculated energy, rise time, peak voltage

DC High Frequency Noise

Input Range	Available Full-Scale Range	Typical Accuracy	Maximum Deviation
3.0-20.0 Vpk-to-pk	20 Vpk-to-pk	±5% of reading ±0.1Vdc	Same as AC

Input filter: High-pass, 4-pole Butterworth, 10.0KHz (3 dB point)
Conversion: Peak detector w/ 100 ms integration
Sampling rate: 12.8 Hz

Probe Input Channels (Generic)

Input Range	Available Full-Scale Ranges	Typical Accuracy	Maximum Deviation
-5.0V - +5.0V	set by probe (0-100°C, 0-100% RH, etc.)	1% of reading	varies with probe type

Code input: -5.0 V - +5.0 V; identifies type of probe
Sampling rate: 1.0 Hz (some probes have peak-hold, trough-hold circuits)
Digital output: Software controlled strobe.

Appendix

A. Graphs

Graphs

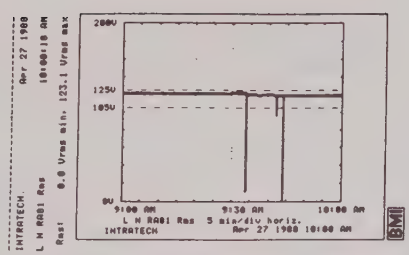
To capture and graph the wide range of disturbances that damage and disrupt electronic equipment, the PowerScope uses several internal measurement systems. The capabilities of each system are independent of the other so you can see even the smallest components of the disturbance at optimum resolution. Each measurement system controls the capture and graphing of four types of power disturbances: long-term disturbances, sags and surges, waveshape faults, and impulses.

Auto zoom

The PowerScope prints four different kinds of graphs corresponding to these disturbances that vary in time duration and resolution: (1) summary strip charts of 1-, 3-, 6-, 12-, or 24-hours, (2) 20-second graphs showing sag or surge disturbances, (3) 125-ms graphs showing waveshape faults, and (4) impulse graphs of varying duration (128 µs, 256 µs, 512 µs, or 1024 µs). The graphs are all the same length physically, but the length of time each pixel or dot on the graph represents varies depending on the length of the disturbance.

Resolution of Summary Strip Charts

Computer equipment can be disrupted by slowly changing voltage levels that occur over several seconds, minutes, or hours. Disturbances of this kind, such as from the load variation on a utility's distribution grid, are clearly presented on the PowerScope's long term summary strip charts. These summaries report Impules, Rms volts, frequency, and high-frequency noise. When optional probes are used, the PowerScope also prints environmental summary strip charts. Summary strip charts are printed at the interval specified by the user in the Report Menu. Strip charts are very helpful when you want to see the overall character of the power, or determine active periods needing closer analysis.



A one-hour summary strip chart showing a voltage sag. If the sag exceeds the programmed threshold, a 20-second sag graph is also printed.

Strip charts are graphed to show the highest and lowest values that occurred over the sampling period. Both these values are graphed with a vertical pixel-line (the top point on the line represents the highest value, the bottom point on the line the lowest value). The sampling period represented by the pixel line varies depending on the strip chart interval, as does the number of samples taken within the sampling period.

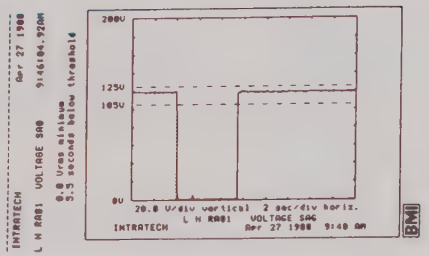
For instance, when making Rms measurements, the PowerScope reports deviations as short as 78 ms, but for a 1-hour strip chart the PowerScope only reports the highest and lowest values for each 14 second time period. For strip charts showing frequency, the sample rate is every 32 cycles, and for strip charts showing environmental probe measurements, the sample rate is 1 second.

Summary Strip Charts

Strip Chart Interval	Time Per Pixel	Samples/Pixel-line		
		Rms	60Hz	Env
1 hour	14 sec	1,794	7	14
3 hours	42 sec	5,384	22	42
6 hours	85 sec	10,897	45	85
12 hours	170 sec	21,794	90	170
24 hours	340 sec	43,589	180	340

Sag/Surge Graphs

Disturbances that have a duration of from 80 ms (5 cycles of 60 Hz power) to several seconds are normally voltage sags and surges. This type of disturbance can be induced by a motor start or stop, for example. The Sag/Surge graphs produced by the PowerScope are 20 seconds long. At this resolution, sags and surges as pictured on a 1-hour summary strip chart are magnified 180 times. Each pixel on a sag/surge graph represents 78 ms.

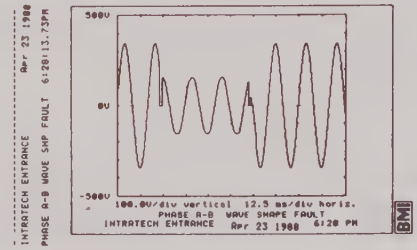


This 20-second sag graph expands by 180 time the disturbance seen on a 1-hour strip chart.

In addition, if the surge (or sag) had a waveshape fault associated with it that exceeded the programmed limits, a waveshape fault graph would be printed by the PowerScope.

Waveshape Fault Graphs

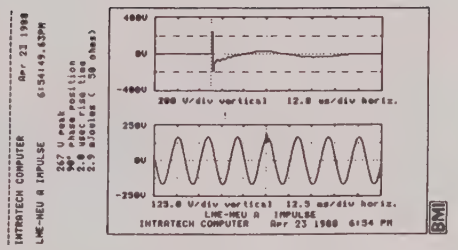
Short disturbances that last between 200 µs (one 30th of a 60 Hz cycle) and 125 ms (7.5 cycles of 60 Hz power) are typically waveshape faults. This type of disturbance can occur, for example, when switching from standby to on-line power. The PowerScope uses a floating-window technique to compare a specified percentage of one cycle to the same percentage of the next cycle. The user selects this amplitude deviation percentage. Waveshape fault graphs are 125 milliseconds long, and at this resolution, expand the disturbance as pictured on a one-hour summary strip chart 28,800 times, and as pictured on a 20 second sag/surge graph 160 times. Each pixel on a waveshape fault graph represents 500 µs (except at high resoltuion, where each pixel represents 0.2 µs).



Waveshape fault graphs are 125 ms long, showing the disturbance at a very enlarged scale.

Impulse Graphs

Instantaneous power disturbances are impulses. Impulses are caused, for example, from a capacitor switching on line. Impulse graphs are triggered when the voltage exceeds the programmed impulse threshold.



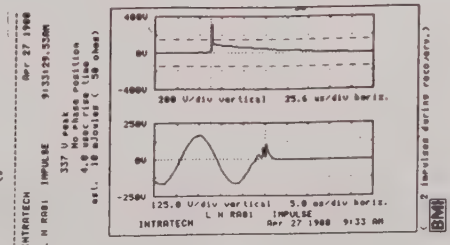
The 128 µs impulse graph (top) magnifies the impulse shown on the wavesgaoe fault graph (bottom) by 1024 times.

The PowerScope captures impulses as short as 0.5µs and graphs the disturbance at an appropriate resolution. Impulse graphs are 128 µsec, 256 µs, 512 µs, or 1024 µs in length, and are combined with waveshape fault graphs to show the position of the impulse on the sinewave.

The PowerScope samples impulses at 2MHz and chooses the best sweep rate for data presentation.

Graph Memory

Frequently, many disturbances happen in a short period of time. All power disturbances will be recognized by your PowerScope, which can store as many as 60 graphs. If disturbances occur while the graph memory is full, they will be counted and added to the strip chart report.



The notation at the far right of this graph indicates how many disturbances occured while the impulse was being processed. These impulses are also counted in the strip chart report.

```
INTRATECH LABS                          May 11 1988

STRIP CHART REPORT                          6:00 PM
 From  3:00 PM  To  6:00 PM

PH A-B     (Channel 1)
 Rms:   119.2 Vrms min,  124.1 Vrms max
 Noise:   0.1 Vpk  min,    1.2 Vpk  max
 Freq:   60.0 Hz   min,   60.0 Hz   max
 Imp:       0 counted

PH B-C     (Channel 2)
 Rms:   118.2 Vrms min,  123.9 Vrms max
 Noise:   0.7 Vpk  min,    1.8 Vpk  max
 Freq:   59.9 Hz   min,   60.0 Hz   max
 Imp:       2 counted,     76  Vpk  max
```

Appendix

B. Recommended Thresholds

*NOTE: Use these thresholds to get started **only** if you lack other data about acceptable power for your application.*

	Nominal Power		Recommended BMI PowerScope Thresholds			
	Voltage	Frequency	Frequency Tolerance	Surge	Sag	Impulse
ABU DHABI	240 Vrms	50 Hz	1.0 Hz	265 Vrms	204 Vrms	400 Vpk
	415 Vrms	50 Hz	1.0 Hz	457 Vrms	352 Vrms	600 Vpk
AFGHANISTAN	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	414 Vrms	323 Vrms	600 Vpk
ALGERIA	127 Vrms	50 Hz	0.8 Hz	140 Vrms	114 Vrms	200 Vpk
	220 Vrms	50 Hz	0.8 Hz	243 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	0.8 Hz	419 Vrms	342 Vrms	600 Vpk
ANGOLA	220 Vrms	50 Hz	1.0 Hz	243 Vrms	184 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk
ANTIGUA	230 Vrms	60 Hz	1.2 Hz	254 Vrms	195 Vrms	700 Vpk
	400 Vrms	60 Hz	1.2 Hz	441 Vrms	340 Vrms	600 Vpk
ARGENTINA	220 Vrms	50 Hz	0.5 Hz	243 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	419 Vrms	342 Vrms	600 Vpk
	390 Vrms	50 Hz	0.5 Hz	430 Vrms	451 Vrms	600 Vpk
AUSTRALIA	240 Vrms	50 Hz	0.5 Hz	255 Vrms	225 Vrms	400 Vpk
	415 Vrms	50 Hz	0.5 Hz	440 Vrms	390 Vrms	600 Vpk
	440 Vrms	50 Hz	0.5 Hz	467 Vrms	413 Vrms	700 Vpk
AUSTRIA	220 Vrms	50 Hz	0.5 Hz	232 Vrms	209 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	400 Vrms	361 Vrms	600 Vpk
AZORES	220 Vrms	50 Hz	0.5 Hz	232 Vrms	209 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	400 Vrms	361 Vrms	600 Vpk
BAHAMAS	120 Vrms	60 Hz	1.2 Hz	133 Vrms	102 Vrms	200 Vpk
	208 Vrms	60 Hz	1.2 Hz	229 Vrms	176 Vrms	300 Vpk
	240 Vrms	60 Hz	1.2 Hz	265 Vrms	204 Vrms	400 Vpk
	415 Vrms	60 Hz	1.2 Hz	457 Vrms	352 Vrms	600 Vpk
BAHRAIN	110 Vrms	50 Hz	1.0 Hz	117 Vrms	103 Vrms	200 Vpk
	220 Vrms	50 Hz	1.0 Hz	234 Vrms	206 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	403 Vrms	375 Vrms	600 Vpk
	400 Vrms	50 Hz	1.0 Hz	425 Vrms	376 Vrms	600 Vpk
	110 Vrms	60 Hz	1.2 Hz	117 Vrms	103 Vrms	200 Vpk
	220 Vrms	60 Hz	1.2 Hz	234 Vrms	206 Vrms	400 Vpk
	380 Vrms	60 Hz	1.2 Hz	403 Vrms	357 Vrms	600 Vpk
	400 Vrms	60 Hz	1.2 Hz	425 Vrms	376 Vrms	600 Vpk
BANGLADESH	230 Vrms	50 Hz	2.0 Hz	242 Vrms	218 Vrms	400 Vpk
	400 Vrms	50 Hz	2.0 Hz	421 Vrms	380 Vrms	600 Vpk

*NOTE: Use these thresholds to get started **only** if you lack other data about acceptable power for your application.*

	Nominal Power		Recommended BMI PowerScope Thresholds			
	Voltage	Frequency	Frequency Tolerance	Surge	Sag	Impulse
BARBADOS	115 Vrms	50 Hz	1.0 Hz	127 Vrms	97 Vrms	200 Vpk
BELGIUM	220 Vrms	50 Hz	0.5 Hz	243 Vrms	187 Vrms	400 Vpk
	240 Vrms	50 Hz	0.5 Hz	255 Vrms	194 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	419 Vrms	323 Vrms	600 Vpk
	400 Vrms	50 Hz	0.5 Hz	441 Vrms	324 Vrms	600 Vpk
	415 Vrms	50 Hz	0.5 Hz	440 Vrms	336 Vrms	600 Vpk
BENIN	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
BERMUDA	120 Vrms	60 Hz	0.6 Hz	153 Vrms	102 Vrms	200 Vpk
	208 Vrms	60 Hz	1.0 Hz	229 Vrms	176 Vrms	300 Vpk
BOLIVIA	110 Vrms	50 Hz	1.0 Hz	122 Vrms	93 Vrms	200 Vpk
BOTSWANA	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
BRAZIL	110 Vrms	60 Hz	1.2 Hz	122 Vrms	93 Vrms	200 Vpk
	127 Vrms	60 Hz	1.2 Hz	140 Vrms	107 Vrms	200 Vpk
	220 Vrms	60 Hz	1.2 Hz	243 Vrms	187 Vrms	400 Vpk
BRUNEI	240 Vrms	50 Hz	1.0 Hz	265 Vrms	204 Vrms	400 Vpk
BULGARIA	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
BURMA	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
BURUNDI	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
CAMBODIA	120 Vrms	50 Hz	1.0 Hz	133 Vrms	102 Vrms	200 Vpk
	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrm	400 Vpk
CAMEROON	127 Vrms	50 Hz	1.0 Hz	140 Vrms	107 Vrms	200 Vpk
	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
CANADA	120 Vrms	60 HZ	0.6 Hz	125 Vrms	110 Vrms	200 Vpk
	208 Vrms	60 Hz	0.6 Hz	217 Vrms	190 Vrms	300 Vpk
	240 Vrms	60 Hz	0.6 Hz	250 Vrms	220 Vrms	400 Vpk
	347 Vrms	60 Hz	0.6 Hz	361 Vrms	318 Vrms	500 Vpk
	480 Vrms	60 Hz	0.6 Hz	500 Vrms	440 Vrms	700 Vpk
	600 Vrms	60 Hz	0.6 Hz	625 Vrms	550 Vrms	900 Vpk
CANARY IS.	127 Vrms	50 Hz	1.0 Hz	140 Vrms	107 Vrms	200 Vpk
	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk

*NOTE: Use these thresholds to get started **only** if you lack other data about acceptable power for your application.*

	Nominal Power		Recommended BMI PowerScope Thresholds			
	Voltage	Frequency	Frequency Tolerance	Surge	Sag	Impulse
CAYMAN IS.	120 Vrms	60 Hz	0.6 Hz	133 Vrms	108 Vrms	200 Vpk
	208 Vrms	60 Hz	0.6 Hz	229 Vrms	187 Vrms	300 Vpk
	227 Vrms	60 Hz	0.6 Hz	250 Vrms	204 Vrms	400 Vpk
	240 Vrms	60 Hz	0.6 Hz	265 Vrms	216 Vrms	400 Vpk
	480 Vrms	60 Hz	0.6 Hz	529 Vrms	432 Vrms	700 Vpk
CENT AFRICAN REP.	220 Vrms	50 Hz	0.1 Hz	243 Vrms	187 Vrms	400 Vpk
CHAD	220 Vrms	50 HZ	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 HZ	1.0 Hz	419 Vrms	323 Vrms	600 Vpk
CHILE	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk
CHINA	220 Vrms	50 Hz	1.0 Hz	236 Vrms	204 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	407 Vrms	353 Vrms	600 Vpk
COLUMBIA	120 Vrms	60 Hz	0.6 Hz	133 Vrms	108 Vrms	200 Vpk
	240 Vrms	60 Hz	0.6 Hz	265 Vrms	216 Vrms	400 Vpk
CONGO	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
COSTA RICA	120 Vrms	60 Hz	1.2 Hz	133 Vrms	102 Vrms	200 Vpk
	240 Vrms	60 Hz	1.2 Hz	265 Vrms	204 Vrms	400 Vpk
CUBA	120 Vrms	60 Hz	1.2 Hz	133 Vrms	102 Vrms	200 Vpk
CYPRUS	115 Vrms	50 Hz	1.3 Hz	122 Vrms	108 Vrms	200 Vpk
	240 Vrms	50 Hz	1.3 Hz	255 Vrms	225 Vrms	400 Vpk
CZECHO -SLOVAKIA	220 Vrms	50 Hz	0.5 Hz	243 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	419 Vrms	342 Vrms	600 Vpk
DAHOMY	220 Vrms	50 Hz	0.5 Hz	243 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 hz	419 Vrms	342 Vrms	600 Vpk
DENMARK	220 Vrms	50 Hz	0.5 Hz	243 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	419 Vrms	342 Vrms	600 Vpk
DOMINICA	230 Vrms	50 Hz	1.0 Hz	254 Vrms	195 Vrms	400 Vpk
	400 Vrms	50 Hz	1.0 Hz	441 Vrms	340 Vrms	600 Vpk

*NOTE: Use these thresholds to get started **only** if you lack other data about acceptable power for your application.*

	Nominal Power		Recommended BMI PowerScope Thresholds			
	Voltage	Frequency	Frequency Tolerance	Surge	Sag	Impulse
DOMINICAN REP.	110 Vrms	60 HZ	1.2 Hz	122 Vrms	93 Vrms	200 Vpk
	220 Vrms	60 Hz	1.2 Hz	243 Vrms	187 Vrms	400 Vpk
DUBAI	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
ECUADOR	110 Vrms	60 Hz	1.2 Hz	122 Vrms	98 Vrms	200 Vpk
	120 Vrms	60 Hz	1.2 Hz	133 Vrms	102 Vrms	200 Vpk
	208 Vrms	60 Hz	1.2 Hz	229 Vrms	176 Vrms	300 Vpk
	220 Vrms	60 Hz	1.2 Hz	243 Vrms	187 Vrms	400 Vpk
	240 Vrms	60 Hz	1.2 Hz	265 Vrms	204 Vrms	400 Vpk
EGYPT	220 Vrms	50 Hz	0.5 Hz	243 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	419 Vrms	342 Vrms	600 Vpk
EL SALVADOR	120 Vrms	60 Hz	0.6 Hz	127 Vrms	114 Vrms	200 Vpk
	240 Vrms	60 Hz	0.6 Hz	253 Vrms	228 Vrms	400 Vpk
ETHIOPIA	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk
FALKLAND IS.	230 Vrms	50 Hz	1.5 Hz	236 Vrms	224 Vrms	400 Vpk
	415 Vrms	50 Hz	1.5 Hz	426 Vrms	404 Vrms	600 Vpk
FIJI IS.	240 Vrms	50 Hz	0.5 Hz	265 Vrms	204 Vrms	400 Vpk
	415 Vrms	50 Hz	0.5 Hz	457 Vrms	352 Vrms	600 Vpk
FINLAND	220 Vrms	50 Hz	0.5 Hz	243 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	419 Vrms	342 Vrms	600 Vpk
	660 Vrms	50 Hz	0.5 Hz	727 Vrms	594 Vrms	1000 Vpk
FRANCE	127 Vrms	50 Hz	0.5 Hz	140 Vrms	114 Vrms	200 Vpk
	220 Vrms	50 Hz	0.5 Hz	243 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	419 Vrms	342 Vrms	600 Vpk
FRENCH GUIANA	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
GABON	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
GAMBIA	230 Vrms	50 Hz	1.0 Hz	242 Vrms	218 Vrms	400 Vpk
	400 Vrms	50 Hz	1.0 Hz	421 Vrms	380 Vrms	600 Vpk
GERMANY (F.REP.)	220 Vrms	50 Hz	0.5 Hz	243 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	419 Vrms	342 Vrms	600 Vpk

B- Recommended Thresholds

*NOTE: Use these thresholds to get started **only** if you lack other data about acceptable power for your application.*

	Nominal Power		Recommended BMI PowerScope Thresholds			
	Voltage	Frequency	Frequency Tolerance	Surge	Sag	Impulse
GERMANY						
	127 Vrms	50 Hz	0.5 Hz	134 Vrms	120 Vrms	200 Vpk
	220 Vrms	50 Hz	0.5 Hz	232 Vrms	209 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	400 Vrms	361 Vrms	600 Vpk
	660 Vrms	50 Hz	0.5 Hz	694 Vrms	627 Vrms	1000 Vpk
GHANA	250 Vrms	50 Hz	2.5 Hz	276 Vrms	225 Vrms	400 Vpk
	440 Vrms	50 Hz	2.5 Hz	485 Vrms	396 Vrms	700 Vpk
GIBRALTAR	240 Vrms	50 Hz	0.5 Hz	255 Vrms	225 Vrms	400 Vpk
	415 Vrms	50 Hz	0.5 Hz	440 Vrms	390 Vrms	600 Vpk
GREECE	220 Vrms	50 Hz	0.5 Hz	232 Vrms	209 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	400 Vrms	361 Vrms	600 Vpk
GREENLAND	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
GRENADA	230 Vrms	50 Hz	1.0 Hz	254 Vrms	195 Vrms	400 Vpk
	400 Vrms	50 Hz	1.0 Hz	441 Vrms	340 Vrms	600 Vpk
GUADELOUPE	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk
	220 Vrms	60 Hz	1.2 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	60 Hz	1.2 Hz	419 Vrms	323 Vrms	600 Vpk
GUAM	120 Vrms	60 Hz	0.6 Hz	130 Vrms	108 Vrms	200 Vpk
	208 Vrms	60 Hz	0.6 Hz	225 Vrms	187 Vrms	300 Vpk
	227 Vrms	60 Hz	0.6 Hz	246 Vrms	204 Vrms	400 Vpk
	240 Vrms	60 Hz	0.6 Hz	260 Vrms	216 Vrms	400 Vpk
	480 Vrms	60 Hz	0.6 Hz	519 Vrms	432 Vrms	700 Vpk
GUATEMALA	120 Vrms	60 Hz	1.0 Hz	133 Vrms	108 Vrms	200 Vpk
	240 Vrms	60 Hz	1.0 Hz	265 Vrms	216 Vrms	400 Vpk
GUYANA	110 Vrms	50 Hz	1.0 Hz	122 Vrms	93 Vrms	200 Vpk
	240 Vrms	50 Hz	1.0 Hz	265 Vrms	204 Vrms	400 Vpk
	110 Vrms	60 Hz	1.2 Hz	122 Vrms	93 Vrms	200 Vpk
	240 Vrms	60 Hz	1.2 Hz	265 Vrms	204 Vrms	400 Vpk
HAITI	115 Vrms	60 Hz	1.2 Hz	127 Vrms	97 Vrms	200 Vpk
	220 Vrms	60 Hz	1.2 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	60 Hz	1.2 Hz	419 Vrms	323 Vrms	600 Vpk
HONDURAS	110 Vrms	60 Hz	1.2 Hz	122 Vrms	93 Vrms	200 Vpk
	220 Vrms	60 Hz	1.2 Hz	243 Vrms	187 Vrms	400 Vpk

*NOTE: Use these thresholds to get started **only** if you lack other data about acceptable power for your application.*

	Nominal Power		Recommended BMI PowerScope Thresholds			
	Voltage	Frequency	Frequency Tolerance	Surge	Sag	Impulse
HONG KONG	200 Vrms	50 Hz	1.0 Hz	213 Vrms	188 Vrms	300 Vpk
	220 Vrms	50 Hz	1.0 Hz	234 Vrms	206 Vrms	400 Vpk
	346 Vrms	50 Hz	1.0 Hz	367 Vrms	325 Vrms	500 Vpk
	380 Vrms	50 Hz	1.0 Hz	403 Vrms	357 Vrms	600 Vpk
	346 Vrms	50 Hz	1.0 Hz	367 Vrms	325 Vrms	500 Vpk
	380 Vrms	50 Hz	1.0 Hz	403 Vrms	357 Vrms	600 Vpk
HUNGARY	220 Vrms	50 Hz	1.0 Hz	232 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	400 Vrms	342 Vrms	600 Vpk
ICELAND	220 Vrms	50 Hz	0.5 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	419 Vrms	323 Vrms	600 Vpk
INDIA	230 Vrms	50 Hz	1.5 Hz	240 Vrms	220 Vrms	400 Vpk
	250 Vrms	50 Hz	1.5 Hz	261 Vrms	240 Vrms	400 Vpk
	400 Vrms	50 Hz	1.5 Hz	417 Vrms	384 Vrms	600 Vpk
	440 Vrms	50 Hz	1.5 Hz	458 Vrms	422 Vrms	700 Vpk
INDONESIA	127 Vrms	50 Hz	0.5 Hz	134 Vrms	120 Vrms	200 Vpk
	220 Vrms	50 Hz	0.5 Hz	232 Vrms	209 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	400 Vrms	361 Vrms	600 Vpk
IRAN	220 Vrms	50 Hz	2.5 Hz	254 Vrms	187 Vrms	400 Vpk
	231 Vrms	50 Hz	2.5 Hz	266 Vrms	196 Vrms	400 Vpk
	380 Vrms	50 Hz	2.5 Hz	438 Vrms	323 Vrms	600 Vpk
	400 Vrms	50 Hz	2.5 Hz	461 Vrms	340 Vrms	600 Vpk
IRAQ	220 Vrms	50 Hz	1.0 Hz	232 Vrms	209 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	400 Vrms	361 Vrms	600 Vpk
IRELAND	220 Vrms	50 Hz	0.5 Hz	234 Vrms	206 Vrms	400 Vpk
	230 Vrms	50 Hz	0.5 Hz	244 Vrms	216 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	403 Vrms	357 Vrms	600 Vpk
	400 Vrms	50 Hz	0.5 Hz	425 Vrms	376 Vrms	600 Vpk
ISRAEL	230 Vrms	50 Hz	1.0 Hz	244 Vrms	216 Vrms	400 Vpk
	400 Vrms	50 Hz	1.0 Hz	425 Vrms	376 Vrms	600 Vpk
ITALY	127 Vrms	50 Hz	0.5 Hz	140 Vrms	114 Vrms	200 Vpk
	220 Vrms	50 Hz	0.5 Hz	243 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	419 Vrms	342 Vrms	600 Vpk
IVORY COAST	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk
JAMAICA	110 Vrms	50 Hz	0.5 Hz	117 Vrms	103 Vrms	200 Vpk
	220 Vrms	50 Hz	0.5 Hz	234 Vrms	206 Vrms	400 Vpk

B Recommended Thresholds

*NOTE: Use these thresholds to get started **only** if you lack other data about acceptable power for your application.*

	Nominal Power		Recommended BMI PowerScope Thresholds			
	Voltage	Frequency	Frequency Tolerance	Surge	Sag	Impulse
JAPAN (EAST)	100 Vrms	50 Hz	0.5 Hz	111 Vrms	90 Vrms	200 Vpk
	200 Vrms	50 Hz	0.5 Hz	221 Vrms	180 Vrms	300 Vpk
JAPAN (WEST)	100 Vrms	60 Hz	0.6 Hz	111 Vrms	90 Vrms	200 Vpk
	200 Vrms	60 Hz	0.6 Hz	221 Vrms	180 Vrms	300 Vpk
JORDAN	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk
KENYA	240 Vrms	50 Hz	1.0 Hz	265 Vrms	204 Vrms	400 Vpk
	415 Vrms	50 Hz	1.0 Hz	457 Vrms	352 Vrms	600 Vpk
KOREA (NORTH)	220 Vrms	60 Hz	1.2 Hz	235 Vrms	190 Vrms	400 Vpk
	380 Vrms	60 Hz	1.2 Hz	406 Vrms	328 Vrms	600 Vpk
KOREA SOUTH	100 Vrms	50 Hz	1.0 Hz	111 Vrms	85 Vrms	200 Vpk
	200 Vrms	50 Hz	1.0 Hz	221 Vrms	170 Vrms	300 Vpk
	240 Vrms	50 Hz	1.0 Hz	265 Vrms	204 Vrms	400 Vpk
	415 Vrms	50 Hz	1.0 Hz	457 Vrms	352 Vrms	600 Vpk
LAOS	220 Vrms	50 Hz	4.0 Hz	234 Vrms	206 Vrms	400 Vpk
	380 Vrms	50 Hz	4.0 Hz	403 Vrms	357 Vrms	600 Vpk
LEBANON	110 Vrms	50 Hz	1.0 Hz	122 Vrms	93 Vrms	200 Vpk
	190 Vrms	50 Hz	1.0 Hz	210 Vrms	161 Vrms	300 Vpk
	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk
LESOTHO	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk
LIBERIA	120 Vrms	60 Hz	2.0 Hz	123 Vrms	117 Vrms	200 Vpk
	208 Vrms	60 Hz	2.0 Hz	212 Vrms	204 Vrms	300 Vpk
	240 Vrms	60 Hz	2.0 Hz	245 Vrms	235 Vrms	400 Vpk
	416 Vrms	60 Hz	2.0 Hz	424 Vrms	408 Vrms	600 Vpk
LIBYA	127 Vrms	50 Hz	1.0 Hz	140 Vrms	107 Vrms	200 Vpk
	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	400 Vrms	50 Hz	1.0 Hz	441 Vrms	340 Vrms	600 Vpk

*NOTE: Use these thresholds to get started **only** if you lack other data about acceptable power for your application.*

	Nominal Power		Recommended BMI PowerScope Thresholds			
	Voltage	Frequency	Frequency Tolerance	Surge	Sag	Impulse
LUXEMBOURG	120 Vrms	50 Hz	0.5 Hz	133 Vrms	108 Vrms	200 Vpk
	208 Vrms	50 Hz	0.5 Hz	229 Vrms	187 Vrms	300 Vpk
	220 Vrms	50 Hz	0.5 Hz	243 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	419 Vrms	342 Vrms	600 Vpk
MALAGASY REP.	127 Vrms	50 Hz	1.0 Hz	131 Vrms	123 Vrms	200 Vpk
	220 Vrms	50 Hz	1.0 Hz	227 Vrms	213 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	392 Vrms	368 Vrms	600 Vpk
MALAWI	230 Vrms	50 Hz	1.0 Hz	254 Vrms	195 Vrms	400 Vpk
	400 Vrms	50 Hz	1.0 Hz	441 Vrms	340 Vrms	600 Vpk
MALAYSIA	240 Vrms	50 Hz	0.5 Hz	253 Vrms	216 Vrms	400 Vpk
	415 Vrms	50 Hz	0.5 Hz	436 Vrms	373 Vrms	600 Vpk
MALI	127 Vrms	50 Hz	1.0 Hz	140 Vrms	107 Vrms	200 Vpk
	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk
MALTA	240 Vrms	50 Hz	0.5 Hz	265 Vrms	204 Vrms	400 Vpk
	415 Vrms	50 Hz	0.5 Hz	457 Vrms	352 Vrms	600 Vpk
MARTINIQUE	127 Vrms	50 Hz	1.0 Hz	140 Vrms	107 Vrms	200 Vpk
	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
MAURITANIA	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
MAURITIUS	230 Vrms	50 Hz	0.5 Hz	244 Vrms	216 Vrms	400 Vpk
	400 Vrms	50 Hz	0.5 Hz	425 Vrms	376 Vrms	600 Vpk
MEXICO	127 Vrms	60 Hz	1.2 Hz	135 Vrms	119 Vrms	200 Vpk
	220 Vrms	60 Hz	1.2 Hz	234 Vrms	206 Vrms	400 Vpk
	277 Vrms	60 Hz	1.2 Hz	294 Vrms	260 Vrms	400 Vpk
	480 Vrms	60 Hz	1.2 Hz	509 Vrms	451 Vrms	700 Vpk
MONACO	127 Vrms	50 Hz	1.0 Hz	140 Vrms	107 Vrms	200 Vpk
	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk
MONTSERRAT	230 Vrms	60 Hz	1.2 Hz	254 Vrms	195 Vrms	400 Vpk
	400 Vrms	60 Hz	1.2 Hz	441 Vrms	340 Vrms	600 Vpk
MOROCCO	115 Vrms	50 Hz	1.0 Hz	127 Vrms	97 Vrms	200 Vpk
	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk

B Recommended Thresholds

*NOTE: Use these thresholds to get started **only** if you lack other data about acceptable power for your application.*

	Nominal Power		Recommended BMI PowerScope Thresholds			
	Voltage	Frequency	Frequency Tolerance	Surge	Sag	Impulse
MOZAMBIQUE	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
NAMIBIA	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
NEPAL	220 Vrms	50 Hz	0.5 Hz	243 Vrms	187 Vrms	400 Vpk
	400 Vrms	0.5 Hz	0.5 Hz	441 Vrms	360 Vrms	600 Vpk
NETHERLANDS	220 Vrms	50 Hz	0.5 Hz	243 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	419 Vrms	342 Vrms	600 Vpk
NETH. ANTILLES	115 Vrms	50 Hz	1.0 Hz	127 Vrms	97 Vrms	200 Vpk
NEW GUINEA	240 Vrms	50 Hz	1.0 Hz	253 Vrms	228 Vrms	400 Vpk
	415 Vrms	50 Hz	1.0 Hz	436 Vrms	394 Vrms	600 Vpk
NEW ZEALAND	230 Vrms	50 Hz	0.8 Hz	242 Vrms	218 Vrms	400 Vpk
	400 Vrms	50 Hz	0.8 Hz	421 Vrms	380 Vrms	600 Vpk
	415 Vrms	50 Hz	0.8 Hz	436 Vrms	394 Vrms	600 Vpk
	440 Vrms	50 Hz	0.8 Hz	463 Vrms	418 Vrms	700 Vpk
NICARAGUA	120 Vrms	60 Hz	1.2 Hz	133 Vrms	102 Vrms	200 Vpk
	240 Vrms	60 Hz	1.2 Hz	265 Vrms	204 Vrms	400 Vpk
NIGER	220 Vrms	50 Hz	0.5 Hz	226 Vrms	214 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	390 Vrms	370 Vrms	600 Vpk
NIGERIA	220 Vrms	50 Hz	0.5 Hz	232 Vrms	209 Vrms	400 Vpk
	230 Vrms	50 Hz	0.5 Hz	242 Vrms	195 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	400 Vrms	323 Vrms	600 Vpk
	400 Vrms	50 Hz	0.5 Hz	421 Vrms	340 Vrms	600 Vpk
NORWAY	220 Vrms	50 Hz	0.5 Hz	243 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	419 Vrms	342 Vrms	600 Vpk
OMAN	240 Vrms	50 Hz	1.0 Hz	265 Vrms	204 Vrms	400 Vpk
	415 Vrms	50 Hz	1.0 Hz	457 Vrms	352 Vrms	600 Vpk
PAKISTAN	230 Vrms	50 Hz	1.0 Hz	254 Vrms	195 Vrms	400 Vpk
	400 Vrms	50 Hz	1.0 Hz	441 Vrms	340 Vrms	600 Vpk
PANAMA	120 Vrms	60 Hz	0.6 Hz	127 Vrms	114 Vrms	200 Vpk
	240 Vrms	60 Hz	0.6 Hz	253 Vrms	228 Vrms	400 Vpk
	277 Vrms	60 Hz	0.6 Hz	291 Vrms	263 Vrms	400 Vpk
	480 Vrms	60 Hz	0.6 Hz	505 Vrms	456 Vrms	700 Vpk

*NOTE: Use these thresholds to get started **only** if you lack other data about acceptable power for your application.*

	Nominal Power		Recommended BMI PowerScope Thresholds			
	Voltage	Frequency	Frequency Tolerance	Surge	Sag	Impulse
PARAGUAY	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk
	440 Vrms	50 Hz	1.0 Hz	485 Vrms	374 Vrms	700 Vpk
PERU	225 Vrms	60 Hz	1.2 Hz	248 Vrms	191 Vrms	400 Vpk
PHILIPPINES	110 Vrms	60 Hz	0.6 Hz	116 Vrms	104 Vrms	200 Vpk
	220 Vrms	60 Hz	0.6 Hz	232 Vrms	209 Vrms	400 Vpk
POLAND	220 Vrms	50 Hz	0.5 Hz	232 Vrms	209 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	400 Vrms	361 Vrms	600 Vpk
PORTUGAL	220 Vrms	50 Hz	0.5 Hz	232 Vrms	209 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	400 Vrms	361 Vrms	600 Vpk
PUERTO RICO	120 Vrms	60 Hz	0.6 Hz	133 Vrms	108 Vrms	200 Vpk
	240 Vrms	60 Hz	0.6 Hz	265 Vrms	216 Vrms	400 Vpk
	480 Vrms	60 Hz	0.6 Hz	529 Vrms	432 Vrms	700 Vpk
QATAR	240 Vrms	50 Hz	1.0 Hz	255 Vrms	225 Vrms	400 Vpk
	415 Vrms	50 Hz	1.0 Hz	440 Vrms	390 Vrms	600 Vpk
RHODESIA	225 Vrms	50 Hz	1.3 Hz	240 Vrms	210 Vrms	400 Vpk
	390 Vrms	50 Hz	1.3 Hz	416 Vrms	364 Vrms	600 Vpk
ROMANIA	220 Vrms	50 Hz	0.5 Hz	232 Vrms	209 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	400 Vrms	361 Vrms	600 Vpk
RWANDA	220 Vrms	50 Hz	0.5 Hz	232 Vrms	209 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	400 Vrms	361 Vrms	600 Vpk
ST. HELENA	230 Vrms	50 Hz	1.0 Hz	254 Vrms	195 Vrms	400 Vpk
ST. KITTS-NEVIS	230 Vrms	60 Hz	1.2 Hz	254 Vrms	195 Vrms	400 Vpk
	400 Vrms	60 Hz	1.2 Hz	441 Vrms	340 Vrms	600 Vpk
ST. LUCIA	240 Vrms	50 Hz	1.0 Hz	265 Vrms	204 Vrms	400 Vpk
	415 Vrms	50 Hz	1.0 Hz	457 Vrms	352 Vrms	600 Vpk
ST. VINCENT	230 Vrms	50 Hz	1.0 Hz	254 Vrms	195 Vrms	400 Vpk
	400 Vrms	50 Hz	1.0 Hz	441 Vrms	340 Vrms	600 Vpk

*NOTE: Use these thresholds to get started **only** if you lack other data about acceptable power for your application.*

	Nominal Power		Recommended BMI PowerScope Thresholds			
	Voltage	Frequency	Frequency Tolerance	Surge	Sag	Impulse
SAUDIA ARABIA	127 Vrms	50 Hz	0.5 Hz	134 Vrms	120 Vrms	200 Vpk
	220 Vrms	50 Hz	0.5 Hz	232 Vrms	209 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	400 Vrms	361 Vrms	600 Vpk
	127 Vrms	60 Hz	0.6 Hz	134 Vrms	120 Vrms	200 Vpk
	220 Vrms	60 Hz	0.6 Hz	232 Vrms	209 Vrms	400 Vpk
	380 Vrms	60 Hz	0.6 Hz	400 Vrms	361 Vrms	600 Vpk
SENEGAL	127 Vrms	50 Hz	1.0 Hz	140 Vrms	107 Vrms	200 Vpk
	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
SEYCHELLES	240 Vrms	50 Hz	1.0 Hz	265 Vrms	204 Vrms	400 Vpk
SIERRA LEONE	230 Vrms	50 Hz	1.0 Hz	254 Vrms	195 Vrms	400 Vpk
SINGAPORE	230 Vrms	50 Hz	0.5 Hz	237 Vrms	223 Vrms	400 Vpk
	400 Vrms	50 Hz	0.5 Hz	413 Vrms	388 Vrms	600 Vpk
SOLOMON IS.	240 Vrms	50 Hz	1.0 Hz	265 Vrms	204 Vrms	400 Vpk
SOMALIA REP.	110 Vrms	50 Hz	1.0 Hz	122 Vrms	93 Vrms	200 Vpk
	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	440 Vrms	50 Hz	1.0 Hz	485 Vrms	374 Vrms	700 Vpk
SOUTH AFRICA	220 Vrms	50 Hz	1.3 Hz	232 Vrms	209 Vrms	400 Vpk
	250 Vrms	50 Hz	1.3 Hz	263 Vrms	237 Vrms	400 Vpk
	380 Vrms	50 Hz	1.3 Hz	400 Vrms	361 Vrms	600 Vpk
	400 Vrms	50 Hz	1.3 Hz	421 Vrms	380 Vrms	600 Vpk
	433 Vrms	50 Hz	1.3 Hz	455 Vrms	411 Vrms	700 Vpk
	500 Vrms	50 Hz	1.3 Hz	526 Vrms	475 Vrms	800 Vpk
SPAIN	127 Vrms	50 Hz	1.5 Hz	136 Vrms	118 Vrms	200 Vpk
	220 Vrms	50 Hz	1.5 Hz	236 Vrms	204 Vrms	400 Vpk
	380 Vrms	50 Hz	1.5 Hz	407 Vrms	353 Vrms	600 Vpk
SRI LANKA	230 Vrms	50 Hz	1.0 Hz	244 Vrms	216 Vrms	400 Vpk
	400 Vrms	50 Hz	1.0 Hz	425 Vrms	375 Vrms	600 Vpk
SUDAN	240 Vrms	50 Hz	1.0 Hz	265 Vrms	204 Vrms	400 Vpk
	415 Vrms	50 Hz	1.0 Hz	457 Vrms	352 Vrms	600 Vpk
SURINAM	115 Vrms	50 Hz	1.0 Hz	127 Vrms	97 Vrms	200 Vpk
	127 Vrms	50 Hz	1.0 Hz	140 Vrms	107 Vrms	200 Vpk
	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	115 Vrms	60 Hz	1.2 Hz	127 Vrms	97 Vrms	200 Vpk
	127 Vrms	60 Hz	1.2 Hz	140 Vrms	107 Vrms	200 Vpk
	220 Vrms	60 Hz	1.2 Hz	243 Vrms	187 Vrms	400 Vpk

*NOTE: Use these thresholds to get started **only** if you lack other data about acceptable power for your application.*

	Nominal Power		Recommended BMI PowerScope Thresholds			
	Voltage	Frequency	Frequency Tolerance	Surge	Sag	Impulse
SWAZILAND	230 Vrms	50 Hz	1.3 Hz	244 Vrms	216 Vrms	400 Vpk
	400 Vrms	50 Hz	1.3 Hz	425 Vrms	376 Vrms	600 Vpk
SWEDEN	220 Vrms	50 Hz	0.5 Hz	243 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	419 Vrms	342 Vrms	600 Vpk
SWITZERLAND	220 Vrms	50 Hz	0.5 Hz	243 Vrms	198 Vrms	400 Vpk
SYRIA	115 Vrms	50 Hz	1.0 Hz	127 Vrms	97 Vrms	200 Vpk
	200 Vrms	50 Hz	1.0 Hz	221 Vrms	170 Vrms	300 Vpk
	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk
TAIWAN	110 Vrms	60 Hz	2.4 Hz	116 Vrms	104 Vrms	200 Vpk
	220 Vrms	60 Hz	2.4 Hz	232 Vrms	209 Vrms	400 Vpk
	380 Vrms	60 Hz	2.4 Hz	419 Vrms	342 Vrms	600 Vpk
TANZANIA	230 Vrms	50 Hz	1.0 Hz	254 Vrms	195 Vrms	400 Vpk
	400 Vrms	50 Hz	1.0 Hz	441 Vrms	340 Vrms	600 Vpk
THAILAND	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk
TOGO	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk
TONGA	110 Vrms	50 Hz	1.0 Hz	122 Vrms	93 Vrms	200 Vpk
	240 Vrms	50 Hz	1.0 Hz	265 Vrms	204 Vrms	400 Vpk
	415 Vrms	50 Hz	1.0 Hz	457 Vrms	352 Vrms	600 Vpk
TRINIDAD/ TOBAGO	115 Vrms	60 Hz	0.6 Hz	122 Vrms	108 Vrms	200 Vpk
	230 Vrms	60 Hz	0.6 Hz	244 Vrms	216 Vrms	400 Vpk
	400 Vrms	60 Hz	0.6 Hz	425 Vrms	376 Vrms	600 Vpk
TUNISIA	220 Vrms	50 Hz	1.0 Hz	243 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	342 Vrms	600 Vpk
TURKEY	220 Vrms	50 Hz	1.0 Hz	243 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	342 Vrms	600 Vpk
UGANDA	240 Vrms	50 Hz	0.5 Hz	251 Vrms	229 Vrms	400 Vpk

B. Recommended Thresholds

*NOTE: Use these thresholds to get started **only** if you lack other data about acceptable power for your application.*

	Nominal Power		Recommended BMI PowerScope Thresholds			
	Voltage	Frequency	Frequency Tolerance	Surge	Sag	Impulse
UNITED ARAB EMIRATES	220 Vrms	50 Hz	0.5 Hz	225 Vrms	215 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	388 Vrms	372 Vrms	600 Vpk
	400 Vrms	50 Hz	0.5 Hz	413 Vrms	388 Vrms	600 Vpk
UNITED KINGDOM	240 Vrms	50 Hz	0.5 Hz	255 Vrms	225 Vrms	400 Vpk
	415 Vrms	50 Hz	0.5 Hz	440 Vrms	390 Vrms	600 Vpk
UNITED STATES	120 Vrms	60 Hz	0.6 Hz	128 Vrms	105 Vrms	200 Vpk
	208 Vrms	60 Hz	0.6 Hz	221 Vrms	183 Vrms	300 Vpk
	240 Vrms	60 Hz	0.6 Hz	255 Vrms	211 Vrms	400 Vpk
	277 Vrms	60 Hz	0.6 Hz	294 Vrms	243 Vrms	400 Vpk
	480 Vrms	60 Hz	0.6 Hz	509 Vrms	422 Vrms	700 Vpk
UPPER VOLTA	220 Vrms	50 Hz	1.0 Hz	203 Vrms	187 Vrms	400 Vpk
URUGUAY	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
USSR	127 Vrms	50 Hz	1.0 Hz	140 Vrms	107 Vrms	200 Vpk
	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk
VENEZUELA	120 Vrms	60 Hz	1.2 Hz	133 Vrms	102 Vrms	200 Vpk
	208 Vrms	60 Hz	1.2 Hz	229 Vrms	176 Vrms	300 Vpk
	240 Vrms	60 Hz	1.2 Hz	265 Vrms	204 Vrms	400 Vpk
VIETNAM	120 Vrms	50 Hz	0.5 Hz	133 Vrms	108 Vrms	200 Vpk
	208 Vrms	50 Hz	0.5 Hz	229 Vrms	187 Vrms	300 Vpk
	220 Vrms	50 Hz	0.5 Hz	243 Vrms	198 Vrms	400 Vpk
	380 Vrms	50 Hz	0.5 Hz	419 Vrms	342 Vrms	600 Vpk
WESTERN SAMOA	230 Vrms	50 Hz	1.0 Hz	254 Vrms	195 Vrms	400 Vpk
YEMEN ARAB REP.	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
YEMEN	250 Vrms	50 Hz	0.5 Hz	261 Vrms	240 Vrms	400 Vpk
	440 Vrms	50 Hz	0.5 Hz	458 Vrms	422 Vrms	700 Vpk
YUGOSLAVIA	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk

*NOTE: Use these thresholds to get started **only** if you lack other data about acceptable power for your application.*

	Nominal Power		Recommended BMI PowerScope Thresholds			
	Voltage	Frequency	Frequency Tolerance	Surge	Sag	Impulse
ZAIRE	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk
	380 Vrms	50 Hz	1.0 Hz	419 Vrms	323 Vrms	600 Vpk
ZAMBIA	230 Vrms	50 Hz	1.3 Hz	239 Vrms	221 Vrms	400 Vpk
	400 Vrms	50 Hz	1.1 Hz	416 Vrms	385 Vrms	600 Vpk
ZIMBABWE	220 Vrms	50 Hz	1.0 Hz	243 Vrms	187 Vrms	400 Vpk

Index

1. Single-phase
2. Dual-Out Phase
3. Three-Phase Delta
4. Three-Phase Wye
5. PCNA Configuration Screens
6. Modules and Accessories
7. Hardware Setup
8. Key Operator Menu
9. Communications Menu
10. Operation
11. Loading Paper
12. Troubleshooting
13. Specifications
A. Graphs
B. Recommended Thresholds
Index
Your Comments Please

A

A-002 Temperature probe 6-4
A-003 Temp/Humidity probe 6-5
A-005 50-Volt Porportional Supply 6-5
A-009 Contact Closure probe 6-6
A-010 Handbook Power Signatures . . . 13-10
A-016 Precision Calibrator 13-9
A-111 AC/DC/Impulse probe 6-2
A-112 Current probe 6-2
A-600 Parallel Processor 6-3
AC measurements 13-12
AC mode, AC/DC/Impulse probe 5-34
AC mode, independent channels 5-8
AC/DC/Impulse probe 6-2
AC/DC/Impulse probe, AC report . . . . 5-74 to 5-77
AC setup . . . . . 5-32 to 5-41
DC report . . . . . 5-74 to 5-77
DC setup 5-42
mode 5-34, 5-44
AC/DC/Impulse report, 3-phase delta . 3-46 to 3-49
3-phase wye . . . . . 4-56 to 4-59
dual 1-phase . . . . . 2-56 to 2-59
AC/DC/Impulse setup, 3-phase delta 3-18 to 3-27
3-phase wye . . . . . .4-22 to 4-31
dual 1-phase . . . . . 2-22 to 2-31
Accessories 6-8
Accessory rack mount 6-8
Acquisition processor 13-3
Amps (current), mode 5-8
report 5-60, 5-72
setup . . . . . 5-28 to 5-31
Attenuator module 13-3
Auto zoom A-1

B

Battery condition 10-4
Baud rate, Communications 9-22, 9-28
internal modem 139

C

Cables ..... See connections
Calendar 8-16, 8-18
Calibration 13-9
CALIBRATION key 10-6
Cancel printer 10-2, 10-8
CANCEL PRINTER key 10-8
Centigrade temperature 8-14
Channel inputs 13-16
Channel name, independent channels 5-10, 5-18
Channel type 5-6
Clock 8-20, 8-22
Communication Menu xiv
Communications modem 13-9
Computer problem xix
Computer site xviii
Connections, 3-phase delta 3-6, 3-50
3-phase wye 4-6, 4-60
custom setup ..... 5-82 to 5-85
dual 1-phase 2-6, 2-60
power conditioner 2-62
single phase 1-6, 1-44
Contact Closure probe 6-6
Current, measurment 5-8
monitoring 5-2
probe 6-2
probe setup 5-28
report 5-60, 5-72
setup menu 5-8
threshold 5-14
Custom setups 5-2

D

Date 8-16, 8-18
Day of month 8-18
DC & custom setups, connections ..... 5-78 to 5-83
report 5-52
setup 5-2
DC impulse, measurement 13-15
threshold 5-50

D

DC, measurement, setup ..... 5-42 to 5-51
mode, main channel 5-8
mode, sensor ..... 5-42 to 5-51
monitoring 5-8
setup menu 5-2
voltage measurement 13-14
voltage threshold ..... 5-46 to 5-49
waveshape faults 13-15
Debugging 12-2
Disk storage, 2460 ..... 7-4 to 7-9
Parallel Processor 6-3
Dual 1-phase, setup menu 2-2
Dual probe rack mount 6-8

E

Electronic Operating Envelope ..... xv, xvi, xvii
Environmental sensor, AC ..... 5-32 to 5-41
current ..... 5-28 to 5-31
DC 5-30, 5-34
European standard date 8-20

Fahrenheit temperature 8-14
50-volt proportional supply 6-5
Firmware 10-7
Floating window wave tolerance 8-6
French language 8-2
Frequency measurement 13-13
Frequency report, 3-phase delta 3-42
3-phase wye 4-46
dual 1-phase 2-46
single phase 1-34

F

Frequency spectrum, 2460 7-3
probe 6-3
Frequency tolerance, 3-phase delta 3-8
3-phase wye 4-8
single phase 1-8
Frequency, nominal, 3-phase delta ... 3-8
3-phase wye 4-8
dual 1-phase 2-8
single phase 1-8
Front panel 13-7

G

Graph memory A-4
Graphs, interpretation 13-10

H

Handbook of Power Signatures 6-8, 13-10
Hardware revision 10-7
Harmonic analysis 7-3
Help messages 8-2
Helpful Hints xviii
HFN measurement, AC 13-14
DC 13-15
HFN report, 3-phase delta 3-40
3-phase wye 4-44, 4-54
custom setups 5-70
dual 1-phase 2-44, 2-54
single phase 1-32, 1-42
HFN setup, 3-phase delta 3-16
3-phase wye 4-20
custom setups 5-26
dual 1-phase 2-20
single phase 1-20
High frequency noise ..... See HFN
High voltage monitoring xxi
Hour 8-20
Hysteresis, voltage threshold 8-10

I

I/O processor 13-5
Impulse, capture 13-4, 13-12
count during recovery A-4
energy 8-14
graphs A-4
Impulse range, 3-phase delta 3-14
3-phase wye 4-14, 4-18
amps 5-16
automatic 8-12
custom setups 5-24
dual 1-phase 2-14
single phase 1-14

I

Impulse report, 3-phase delta 3-38
3-phase wye 4-42, 4-52
amps ..... 5-28 to 5-31, 5-62
custom setups 5-68
dual 1-phase 2-42, 2-52
single phase 1-30, 1-40
Impulse threshold, 3-phase delta 3-12
3-phase wye 4-16
amps 5-14
dual 1-phase 2-12
single phase 1-12
Initial waveshape, 3-phase delta 3-32
3-phase wye 4-36
amps 5-56
dual 1-phase 2-36
single phase 1-36
Input channels 13-16
Internal modem 9-4
Internal UPS 8-16

K

Key Operator Menu xiii
Keyboard xii
Keyboard lock 10-4

L

Line impedance 8-14
LOCK key 10-4

M

Master PowerScope ..... 9-2, 9-10 to 9-17, 9-30
Mathematics processor 13-5
Measurement, AC 13-12
Mechanical specifications 13-8
Memory, name 8-24
read/write 8-24
setup menu 10-8, 10-10
Minute (time of day) 8-22
Mode of channel 5-8
Modem, accessory 6-8
communications ..... 9-4 to 9-12, 9-20 to 9-25
internal 13-9

M

MONITOR ..... x, xi, 10-2
Monitoring ..... v, 1-45
Monitoring, high voltage xxi
Month 8-16
Motherboard 13-7

N

Name, channel 5-10, 5-18, 5-42
Neutral-Ground, dual 1-phase 2-16, 2-18
  mode 5-8, 5-20
  name 5-20
  single phase 1-16, 1-18

O

Off mode 5-8
Options supported 10-7

P

Paper, loading 11-2
Parallel processor 6-3
Power conditioner xx
Power supply 13-8
PowerScope, 2460 7-2
  front panel 13-7
  input 13-3
    internal communications 13-5
  mechanical 13-8
  motherboard 13-7
  power supply 13-8
  printer 13-6
  processors 13-3
  specifications 13-2
  supply voltage iv
PowerTalk software 6-3, 6-8
Preventive monitoring xxi
Printer, cancel 10-2, 10-8
  interface 13-6
  on/off 7-6
    on/off, slave PowerScope 9-18, 9-32
Probe, AC/DC/Impulse 6-2
Probes, ... 6-2
Problems with the PowerScope 12-2
Proportional supply probe 6-5

R

Rack mount 6-8
RECALL SETUP key ..... vii, 10-10
Recommended thresholds B-1
Report interval .....
Report menu, 3-phase delta 3-28
3-phase wye 4-32
AC/DC/Impulse probe 5-52, 5-74
dual 1-phase 2-32
single phase ..... xiii, 1-22
Report summary, 3-phase delta 3-53
3-phase wye 4-63
custom setups 5-87
dual 1-phase 2-65
single phase 1-47
Resolution, strip chart A-2
Rms, current report 5-60
voltage measurement 13-13
Rms voltage report, 3-phase delta ... 3-36
3-phase wye 4-12, 4-16, 4-40
custom setups 5-66
dual 1-phase 2-40, 2-50
single phase 1-28, 1-38
RS-232 port ..... 9-8, 9-26 to 9-33
RUN/LOAD lever 11-2, 11-5

S

Safety ..... Inside Front Cover
Sag amps 5-12
Sag graphs A-3
Sag voltage, 3-phase delta 3-10
3-phase wye 4-10
custom setups 5-22
dual 1-phase 2-10
single phase 1-10
SELF TEST key 10-6
Setup memory, name 8-24
read/write 8-24

Setup menu, 3-phase delta 3-2
3-phase wye 4-2
communications 9-2
custom setups 5-2
dual 1-phase 2-2
probes 5-32, 5-42
single phase ..... x, xiii, 1-2
storage 10-8, 10-10
Setup summary, 3-phase delta 3-52
3-phase wye 4-62
custom setups 5-86
dual 1-phase 2-64
single phase 1-46
Single phase, setup 1-2
type 1-6
Site name, 3-phase delta 3-4
Site name, 3-phase wye 4-4
custom setups 5-4
dual 1-phase 2-4
single phase 1-4
Slave PowerScope ..... 9-2, 9-10 to 9-21, 9-32
Software, PowerScope 13-2
STATUS key 10-4
Storage menu 7-4
STORE MEMORY key 10-8
Strip chart report, 3-phase delta 3-34
3-phase wye 4-38
custom setups 5-58
dual 1-phase 2-32, 2-38
single phase 1-26
Strip chart resolution A-2
Strip chart summary A-2
Summary reports, 3-phase delta 3-2
3-phase wye 4-2, 4-32
custom setups 5-2, 5-52
dual 1-phase 2-2
single phase 1-2, 1-22
Summary strip charts A-2

S

Surge amps 5-12
Surge graphs A-3
Surge voltage, 3-phase delta 3-10
3-phase wye 4-10
custom setups 5-22
dual 1-phase 2-10
single phase 1-10
Surge, terminology 8-4
Swell, terminology 8-4

T

Technical specifications 13-2
Telephone line connection 9-4
Telephone numbers 9-10, 9-12
Temperature probe 6-4
Temperature, units 8-14
Temperature/humidity probe 6-5
Terminology, disturbance 8-4
THD ..... See total harmonic distortion
Three phase delta, report 3-28
setup 3-2
Three phase wye, report 4-32
setup 4-2
Threshold report, 3-phase delta 3-30
3-phase wye 4-34
custom setups 5-54
dual 1-phase 2-34
single phase 1-24
Thresholds, recommended B-1
Time of day 8-20, 8-22
Total harmonic distortion, 2460 7-3
Total harmonic distortion, probe 6-3
Type of channel 5-6
Type power, 3-phase delta 3-6
3-phase wye 4-6
dual 1-phase 2-6
single phase 1-6

U

Unlocking the keyboard 10-4
UPS, internal 8-16

W

Wave tolerance envelope 8-6
Waveshape detection 13-4
Waveshape disturbance, 3-phase delta 3-44
3-phase wye 4-48
amps 5-64
dual 1-phase 2-48
single phase 1-24
Waveshape fault, detection 13-12
duration 8-6
graphs A-3
Waveshape graphs, resolution 8-8
Waveshape, initial .....

Y

Year 8-18, 8-20
Your opinion please ..... Rear

Z

Zoom in, automatic A-1

Your comments please

Please help us to improve our products and publications. After you review this manual, please take a moment to answer the questions below.

1. How would you rate the following?	Very Easy	Fairly Easy	Fairly Difficult	Very Difficult
a) Ease of reading this manual.	☐	☐	☐	☐
b) Ease of locating information in the manual.	☐	☐	☐	☐
c) Ease of learning to use the PowerScope.	☐	☐	☐	☐

2. What areas of difficulty have you found in learning to use the BMI PowerScope?

_____

_____

3. What changes would you recommend?

_____

_____

4. How frequently do you face power problems in which you expect to use the BMI PowerScope?

Daily, On-Going ☐ Few Times Per Week ☐ Few Times Per Month ☐ Less than Once Per Month ☐

5. For which specific applications do you anticipate using the BMI PowerScope? (e.g., monitoring power conditioner output, DC, computers, etc.)

_____

_____

6. Please list any comments or suggestions you may have that would help us provide better service.

_____

_____

_____

Thank you for your help. Please return this questionnaire to:

2400 Manual

BASIC MEASURING INSTRUMENTS
335 LAKESIDE DRIVE
FOSTER CITY, CA 94404-1147

1. Single-phase
2. Dual-One Phase
3. Three-Phase Delta
4. Three-Phase Wye
5. DC or Custom Setups
6. Probes and Accessories
7. If you have a 2460
8. Key Operator Menu
9. Communications Menu
10. Operation
11. Loading Paper
12. Troubleshooting
13. Specifications
A. Graphs
B. Recommended Thresholds
Index
Your Comments Please

Basic Measuring Instruments
335 Lakeside Drive
Foster City, CA 94404
(415) 570-5355